DNA 3964F-1-1

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THE ROSCOE MANUAL

Volume I-1 – Program Description

General Research Corporation
P.O. Box 6770
Santa Barbara, California 93111

29 February 1980

Final Report for Period 9 November 1978–29 February 1980

CONTRACT No. DNA 001-78-C-0002

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Prepared for
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(11) REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPO~~RT NUMBER~~ (18) DNA 3964F-1-1	2. GOVT ACCESSION NO. AD-A092 917	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* (6) THE ROSCOE MANUAL, Volume I-1-Program Description.		5. ~~TYPE OF REPORT~~ & PERIOD COVERED (7) Final Report, for Period 9 Nov 78—29 Feb 80
	(14)	6. ~~PERFORMING ORG. REPORT NUMBER~~ CR-1-520, ~~Vol. 1/1~~ VOL-1-1
7. AUTHOR(s) J. R. Garbarino	(15)	8. ~~CONTRACT OR GRANT NUMBER(s)~~ DNA 001-78-C-0002
9. PERFORMING ORGANIZATION NAME AND ADDRESS General Research Corporation ✓ P.O. Box 6770 Santa Barbara, California 93111	(16)	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS (12) ~~Subtasks~~ S99QAXHC064-28 ~~and~~ S99QAXHC064-32
11. CONTROLLING OFFICE NAME AND ADDRESS Director Defense Nuclear Agency Washington, D.C. 20305	(11)	12. ~~REPORT DATE~~ 29 Febr~~uary~~ 1980
		13. NUMBER OF PAGES 124
14. MONITORING AGENCY NAME & ADDRESS *(if different from Controlling Office)*		15. SECURITY CLASS *(of this report)* UNCLASSIFIED
		15a. DECLASSIFICATION DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

This work sponsored by the Defense Nuclear Agency under RDT&E RMSS Codes B322074464 S99QAXHC06428 H2590D and B322075464 S99QAXHC06432 H2590D.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Nuclear Effects
Radar
Optical Sensors
Computer Program
Simulation
Ballistic Missile Defense

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The ROSCOE computer code is designed specifically to be the "laboratory standard" for evaluating nuclear effects on radar and optical sensors. The program provides a means for (1) evaluating radar acquisition, discrimination, and tracking performance in a nuclear environment, (2) determining optical (SWIR) surveillance and tracking performance in the presence of nuclear effects, (3) measuring the degradation of microwave satellite communications systems due to transmission through nuclear disturbed regions, (4) estimating

20. ABSTRACT (Continued)

various radar and optical propagation error sources, and (5) computing specific phenomenological data.

The ROSCOE documentation consists of a number of volumes; including user manuals (Volumes 1-3), systems code descriptions (Volumes 4, 20, and 21-1), code validation documents (Volumes 6 and 23), and phenomenology code descriptions (all others).

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1 INTRODUCTION

The ROSCOE computer code was designed specifically to be the "laboratory standard" for evaluating nuclear effects on radar and optical sensors. The design philosophy was to take "state-of-the-art" phenomenology models, couple these with a generalized systems modeling framework to allow the user flexibility in structuring different kinds of engagements, and finally, place these in a code structure that would be flexible for change and use. The idea was that ROSCOE would be used as a framework for the development of new physics models by the physicist-user, and as a technology assessment tool by the systems analyst.

The ROSCOE computer code provides an effective means for evaluating these kinds of problems:

1. Radar acquisition, discrimination, and tracking performance in a nuclear environment.
2. Optical (SWIR) surveillance and tracking in the presence of nuclear effects.
3. The degradation of microwave satellite communication systems due to transmission through nuclear disturbed regions.
4. Estimates of radar and optical propagation error sources along specified lines-of-sight.
5. Specific phenomenological data in nuclear disturbed regions for use in other codes or for validating faster running codes.

The phenomenology portion of the code consists of a number of modules, each representing a major calculation type (e.g., chemistry, fireball properties and motion, weapon output, etc.). For each module type, existing phenomenology codes were surveyed to find candidate models for ROSCOE. Models were then selected considering computer constraints and the concept of "balanced accuracy" to yield the first-order ROSCOE phenomenology models.

These were then modified where necessary to match the latest test data and to include new phenomenological concepts.

The systems portion of the code consists of a flexible input/output structure and a library of systems routines from which specific systems modules can be built. For example, the user can specify multi-object attacks with varying object types and weapon types, multiple sensors of varying type, and various output options for many different system applications. General models of a phased-array radar and optical surveillance sensor are also available within the code. The user can simulate his particular radar or optical sensor by specifying a set of input parameters to these models, or he can replace these sensor models with his own. Similarly, simple models for the system functions of radar track and discrimination, optical surveillance, and satellite communications are provided, but can be replaced.

The code structure has been designed to allow for flexibility in making changes so that new phenomenology models can be inserted as they become available and other systems models can be added. The code is event-based, with each event consisting of an overlay of routines which compute some specific set of calculations. For example, many of the phenomenology modules mentioned above are separate events within the code. Thus, to change a phenomenology module, the user would write a replacement event for the one currently in ROSCOE, and insert it in the program structure file. Overlays are constructed at run time by the user, who selects the subroutines which are to be loaded from the program library. Thus to change a subroutine, the user merely inserts his subroutine in the program library and modifies the structure file to insert it in the proper overlay.

The program has several run options. First, the phenomenology block of the code (consisting of several overlays) can be run independently so that detailed phenomenology calculations can be made; second, radar and optical sensor propagation errors can be computed along specified lines-of-sight; third, the system models (radar track and discrimination, optical surveillance, or satellite communications) can be run independently--in an undisturbed environment; and finally, the systems models can be run in a nuclear environment.

The ROSCOE documentation is divided into thirty-six volumes including user manuals (Volumes 1-3), systems code descriptions (Volumes 4, 20 and 21-1), code validation documents (Volumes 6 and 23), and phenomenology code descriptions (all others). This volume is subdivided into two main sections. The first section, "Understanding ROSCOE", is designed to help the user understand the basic design and content of the code. This is followed by the section, "Using ROSCOE", which describes some elements of the program structure, the input/output routines, and the input/output variables.

2 UNDERSTANDING ROSCOE

This section begins with a program overview to acquaint the reader with the basic assumptions made in developing the program and the computational flow of the code. Brief descriptions of the systems and physics models are given later.

2.1 OVERVIEW

2.1.1 Scenario

The basic scenario which ROSCOE is intended to simulate is shown in Fig. 2.1. One or more sensors on various platforms attempt to discriminate, track or view one or more objects in the presence of a multiburst nuclear environment. Both high-altitude and low-altitude phenomenology modules are available in the code, and they can be run simultaneously.

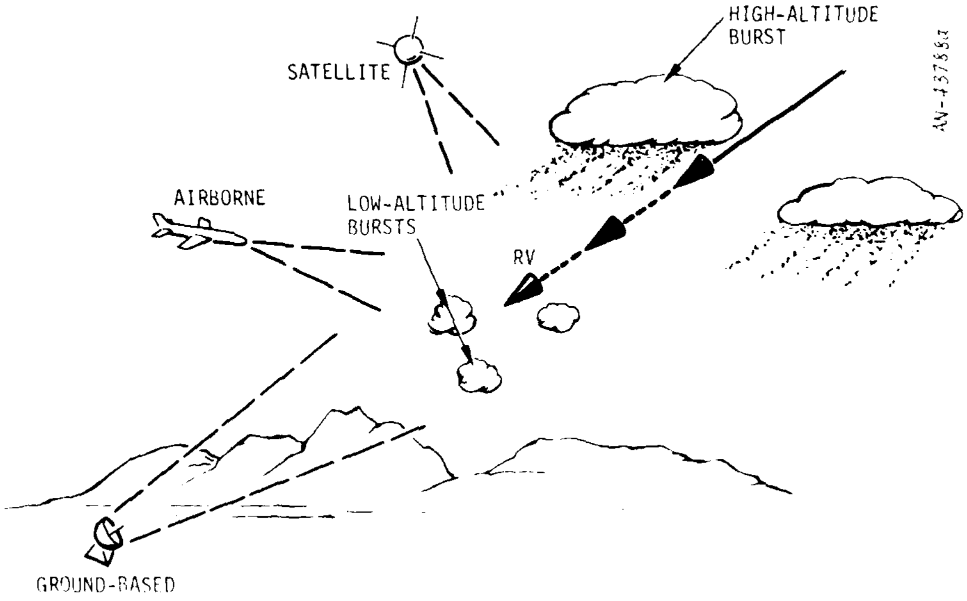


Figure 2.1. ROSCOE Scenario

The sensor platform types include ground-based, airborne and space-borne. Various sensor types can be specified. For example, radars with differing characteristics can be specified in a single run.

Similarly, a number of different object types can be specified in the input. These object types can be mixed in any desired fashion to generate quite complicated attacks.

There are no interceptors modeled in ROSCOE. Interceptor bursts as well as precursor bursts are specified in the input by designating a burst time and location. Weapon types can be mixed as required to simulate a specific engagement.

2.1.2 Basic Assumptions

The main portions of the ROSCOE code are written in Fortran IV, specifically in the version which is currently running on the 6000 and 7000 series computers of Control Data Corporation. In addition, there are a few machine-language subroutines taken from the GRC TRAID[1] library of BMD systems routines.

ROSCOE uses a spherical, rotating earth for trajectory calculations with a Cartesian coordinate system fixed in the earth. This coordinate system has the z-axis pointing out of the geographical north pole, the x-axis out of the equator at the Greenwich meridian, and the y-axis selected to complete a right-handed orthogonal triple (see Fig. 2.2). Since the coordinate system is a rotating one, object motion contains centrifugal and Coriolis terms. Motion of the earth around the sun is ignored except for some atmospheric calculations which require the solar position and flux.

[1] T. Plambeck, The Compleat Traidsman, General Research Corporation IM-711/2, September 1968.

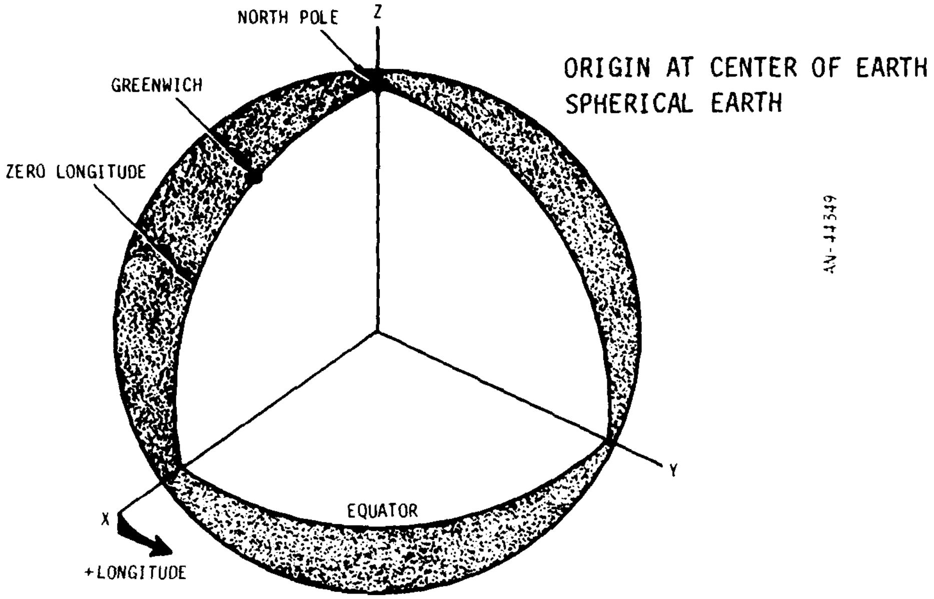


Figure 2.2. Coordinate System

Internal calculations are performed in the CGS system of units. Input and output can be in any units convenient to the user, but nonstandard units will be converted to the CGS system within the program.

Two special-purpose program libraries are used in ROSCOE. The first is a BMD systems library of subroutines called TRAID.[1] It provides trajectory-generating programs, input/output routines, and some standardized vector and matrix routines.

The second program library used in ROSCOE is GRC's Dynamic Storage Allocation (DSA)[2] system. It provides an orderly data base structure which is a key element in allowing for modularity in the code. Basically, it replaces the usual organization of data into large multiply-dimensioned arrays, which are accessed by means of indexing and searched by means of Fortran DO-loops, by a scheme which organizes the data into individual datasets (a list or vector of words) which are, in turn, organized into

[1] T. Plambeck, The Compleat Traidsman, General Research Corporation IM-711/2, September 1968.

[2] R.L. Stone, A Dynamic Storage Allocation System for Fortran Programs, General Research Corporation IMR- 1249, January 1970.

lists. Routines are provided in the package to enable the programmer to search lists and access any dataset once the data structure is known. This allows the model designer to put together extremely complex data structures without making use of large arrays.

The above program libraries are used primarily in the systems modules and in the physics interface structure of the code. The physics modules have been left in standard Fortran, with a few minor exceptions to allow for communications between subroutines, so that these routines can be individually transferred to the user community.

2.1.3 Computational Flow

A simplified view of the computational flow of the radar version[1] of the program is shown in Fig. 2.3. The systems modules are shown at the top of the figure, and the physics modules at the bottom.

The systems model is made up of an attack generation event, which initializes the ambient atmosphere and magnetic field models and sets up the attack by calling launch and impact events; a radar event, which performs the radar function of search, verification, track initiation, and track; and a radar signal processing event, which computes all propagation losses along a line-of-sight, and filters the radar returns to point the radar for the next "look".

The physics model consists of a burst event which creates the initial burst patameters, two update events to update the low-altitude and high-altitude phenomenology, and an interpolation routine to interpolate the physics data at times specified in the input or at times specified by the systems calculations.[2] In addition, there is a point properties

[1] See Volumes 20 & 21-1 for the communications and optical systems model, respectively.

[2] Many of the physics variables are updated on a periodic basis and their values stored for only two widely spaced times, to reduce computation time. The data is then interpolated for times intermediate to the stored times.

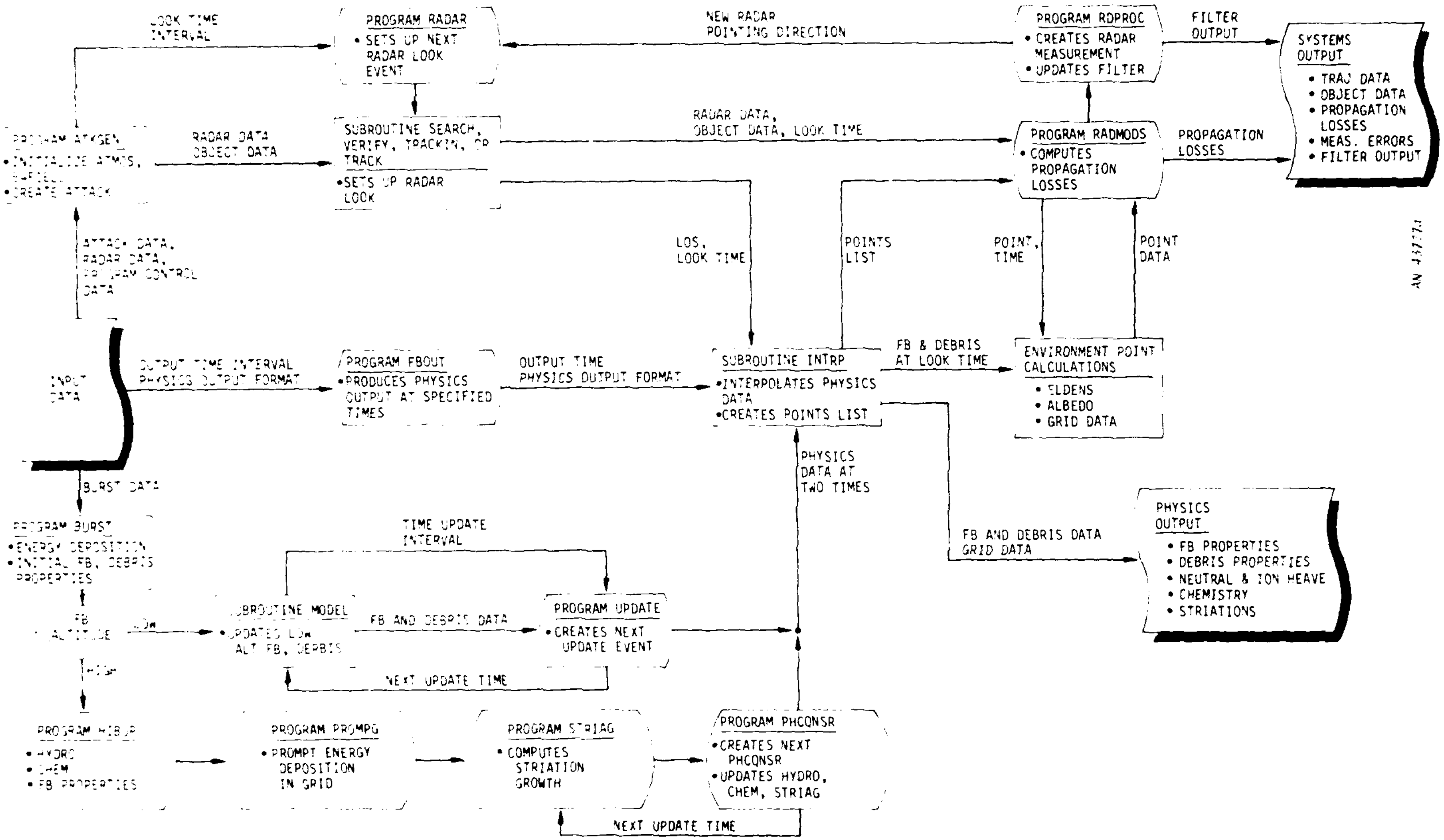


Figure 2.3. ROSCOE Basic Data Flow

routine which provides physical data at specified points as requested for propagation calculations.

Output occurs in two ways: (1) specific physics and system data can be output at program termination, and/or (2) individual data and some special printer plots of specific physics data can be output as they are produced within the program. These output options can be set up in the input deck.

2.2 THE SYSTEM MODEL

As mentioned above, the system model consists of a generalized framework from which the user can design his particular system simulation. Some very general system applications models have been provided as examples; including, radar track and discrimination, optical surveillance and satellite communications.

Each of these system applications models are structured in the same way. Each starts with the attack generation event to initialize the ambient atmospheric properties and to create the attack if appropriate. This is followed by one or more events which perform the signal generating, processing and output functions.

As an example, the three major modules or "events" which make up the radar track simulation are attack generation, radar, and signal processing. A brief description of these modules is given below. For further details on the radar system models see Volume 4. The reader is referred to Volumes 20 and 21-1 for descriptions of the satellite communications and optical surveillance system models, respectively.

2.2.1 Attack Generation

The attack generation module consists of a general attack generator, some initialization routines, and a set of object observable models. The attack generator is basically derived from the GRC BAG 14 code.[1]

[1] L.R. Ford and T.O. Sullivan, An Overview of BAG XIV: A Simulation for Hardsite Defense, General Research Corporation IMR-1484, March 1971.

The input consists of a set of launch points and impact points, a set of object types, and the number of objects of each type. Object types are tied to the launch points, and the number of objects of a given type and the timing of the attack are tied to the impact points. Thus by merely ordering the launch point and impact point lists properly, one can generate complicated attacks.

Initialization of the ambient atmosphere, the geomagnetic field, and the high-altitude grid[1] (if appropriate) are also performed in this module. Initial ambient atmospheric properties (solar flux, time of day and year, etc.) are set up by a call to the ambient atmosphere subroutine with an appropriate initialization flag. A dipole magnetic field is fitted to a central battlespace[2] location specified in the input. Grid initialization sets up the physical dimensions and orientation of the high-altitude grid and battlespace region. It also calls the ambient atmosphere and ionospheric routines, and assigns appropriate ambient properties to each grid cell. If striation calculations are desired, a magnetic grid region (a gridded plane normal to the magnetic field at the center of the grid) is also established.

Object observables models are used to identify each object type. Models can be specified for ballistic coefficient, radar cross section, wake radar cross section, tumbling dynamics, and radar cross section sheathing. There are a number of options available for each model. For example, the ballistic coefficient can be modeled as a constant, computed from a cone-aerodynamics model, or input as a tabular function of altitude.

2.2.2 Radar

Scope. The radar model basically represents a phased-array tracker, specified by the characteristics shown in Table 2.1.

[1] For altitudes above about 90 km, the battlespace is divided into as many as 1300 cells. Atmospheric and ionospheric properties of the disturbed environment are computed at cell centers and interpolated in time and space.

[2] "Battlespace", as used here, refers to the spatial extent of the nuclear environment.

The search/detection/verification procedure uses a search sector that is limited in angular extent by input values of elevation and azimuth, and has a range-height transition which defines its range limit (i.e., it is limited by either range or altitude). The search sector is also assumed to have an inner boundary in range (see Fig. 2.4).

TABLE 2.1

FEATURES OF THE RADAR MODEL

- Multiple Faces
- Search Sector (with H, R, A, E limits)
- Antenna Patterns
    - Mainlobe plus constant sidelobe
    - Mainlobe plus tapered sidelobe
- Range Gating
- Monopulse
- Range Marking
    - Peak Signal
    - Split-gate
- Waveforms
    - Rectangular
    - Frequency modulated (chirped) pulse
- Waveform Dispersion
- Measurement Errors
    - Bias
    - Random

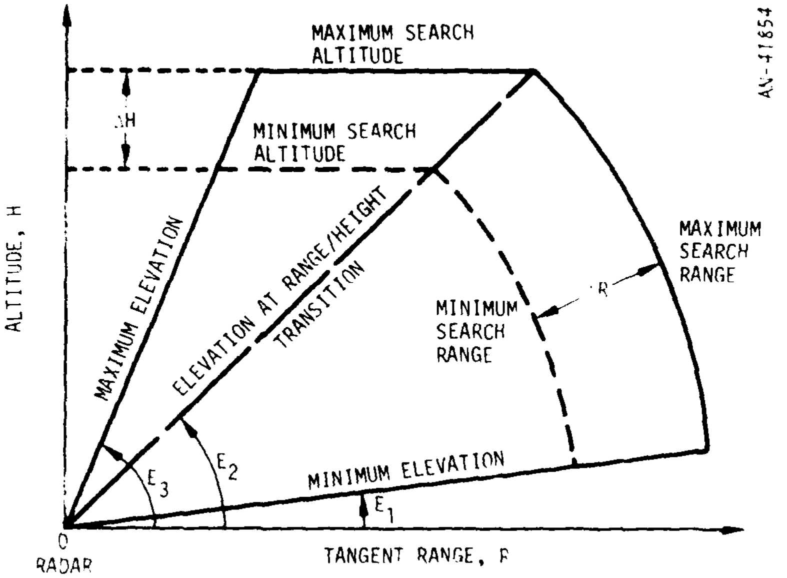


Figure 2.4. Vertical Slice Through Search Sector With Range-Height Transition

Several different antenna patterns can be modeled, including a mainlobe-plus-constant-sidelobe model (where the mainlobe is assumed to have the form (sin x)/x), and a mainlobe-plus-tapered-sidelobe model.

Range gating is performed at each radar "look", based on the filter estimate of the target position, to determine when the target is lost due to refraction or poor prediction.

For the track function, a monopulse system is modeled for angle tracking, and a range marking system is used for range tracking. A split-gate range marking system is used in track, while a simple peak-signal model is used during search.

Two simple waveforms are available: a rectangular pulse and a chirped pulse. They can be used for either search or track.

Finally, a waveform dispersion model is incorporated in the code, as are bias and random measurement errors (see Vol. 4 for details).

Radar Event Logic. A simplified view of the radar event logic is shown in Fig. 2.5. It consists of five main events: initialization, search, verification, track initiation, and track. This scheme is representative of a generalized BMD radar system.

Each block in the figure represents one pulse by the radar in an attempt to put an object into track. Note that after each pulse the ratio of the signal-to-noise-plus-clutter is tested against a threshold value to see if the next event can be processed. If the test fails while in search or verification, a subsequent search pulse is made. If a failure occurs after one track initiation pulse, a second track initiation pulse is attempted before returning to search. Finally, if the threshold test fails while in track, additional track pulses are attempted until a successful pulse is received, or the total unsuccessful track time exceeds a threshold (an input) and then the object is classified as "lost". Note that two successful track initiation pulses are required in order to put an object into track (i.e., establish a track file for the object/sensor pair).

2.2.3 Signal Processing

General Features. The signal-to-noise-plus-clutter ratio is computed from the following equation:

$$\frac{S}{N + C} = (S/N)_T (R_o/R)^4 \frac{F_T F_R \sigma \cos^2 \theta}{L_2 L_D L_F [1 + (T_X/T_N) + (C/N_N)]}$$

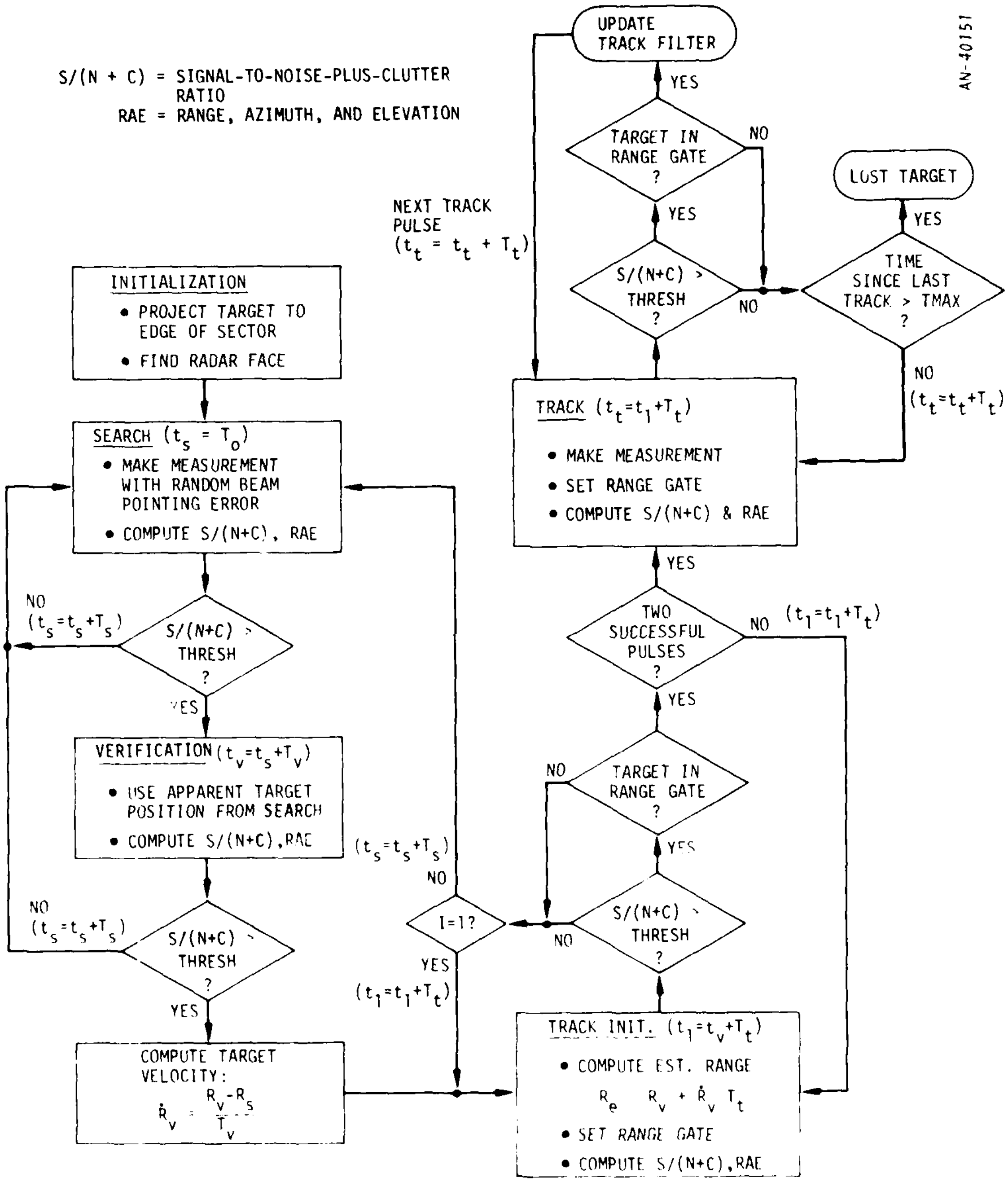


Figure 2.5. Radar Event Logic

where L_2 = two-way absorption loss factor

L_D = dispersive loss

L_F = Faraday rotation loss

T_X = noise temperature, °K

T_N = system noise temperature, °K

C/N_N = clutter-to-noise ratio

θ = off-boresight angle

F_T, F_R = off-beam-axis gains for transmit and receive

σ = radar cross section of target, cm^2

R_o = range (cm) at which threshold is achieved on a one-square-centimeter target

R = range to the target, cm

$(S/N)_T$ = signal-to-noise ratio threshold

The measured target position is determined as shown in Fig. 2.6. First, the actual target position is corrupted by refraction to yield a refracted target location. Then the apparent target position is computed by considering the monopulse return and any multiple images that may occur due to multipath effects. Finally, radar measurement errors are added to the apparent target coordinates to yield the measured target location.

Signal Processing Logic. The signal processing logic, illustrated in Fig. 2.7, carries out the determination of signal-to-noise-plus-clutter ratio and measured target location in the following series of steps. The simplest factors are computed first so that, if the target signal is below threshold, the more complicated factors need not be computed.

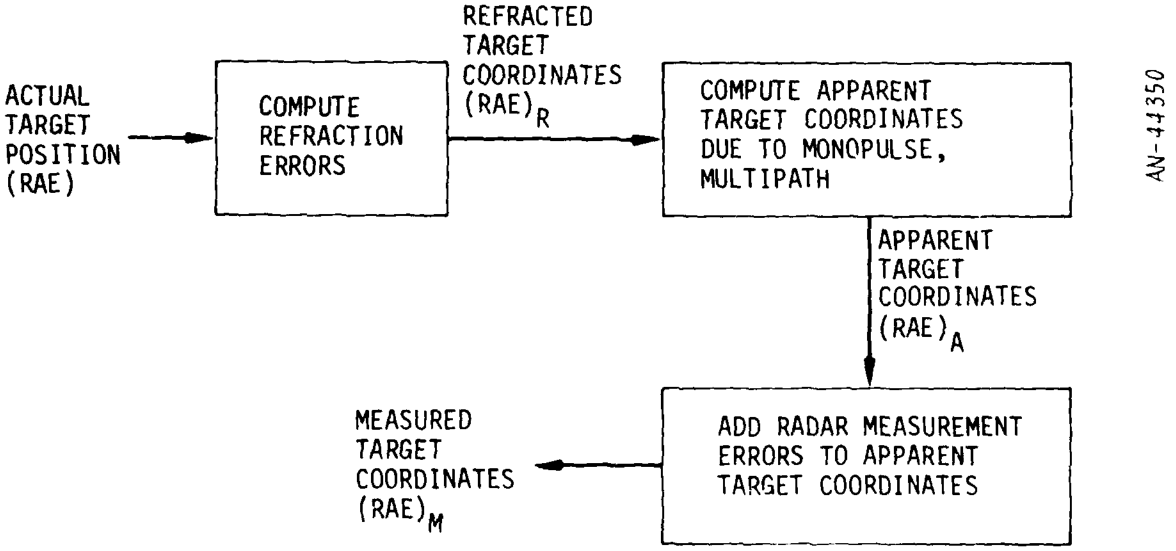

ACTUAL TARGET POSITION (RAE)
COMPUTE REFRACTION ERRORS
REFRACTED TARGET COORDINATES $(RAE)_R$
COMPUTE APPARENT TARGET COORDINATES DUE TO MONOPULSE, MULTIPATH
APPARENT TARGET COORDINATES $(RAE)_A$
ADD RADAR MEASUREMENT ERRORS TO APPARENT TARGET COORDINATES
MEASURED TARGET COORDINATES $(RAE)_M$
AN-44350

Figure 2.6. Generation of the Measured Target Coordinates

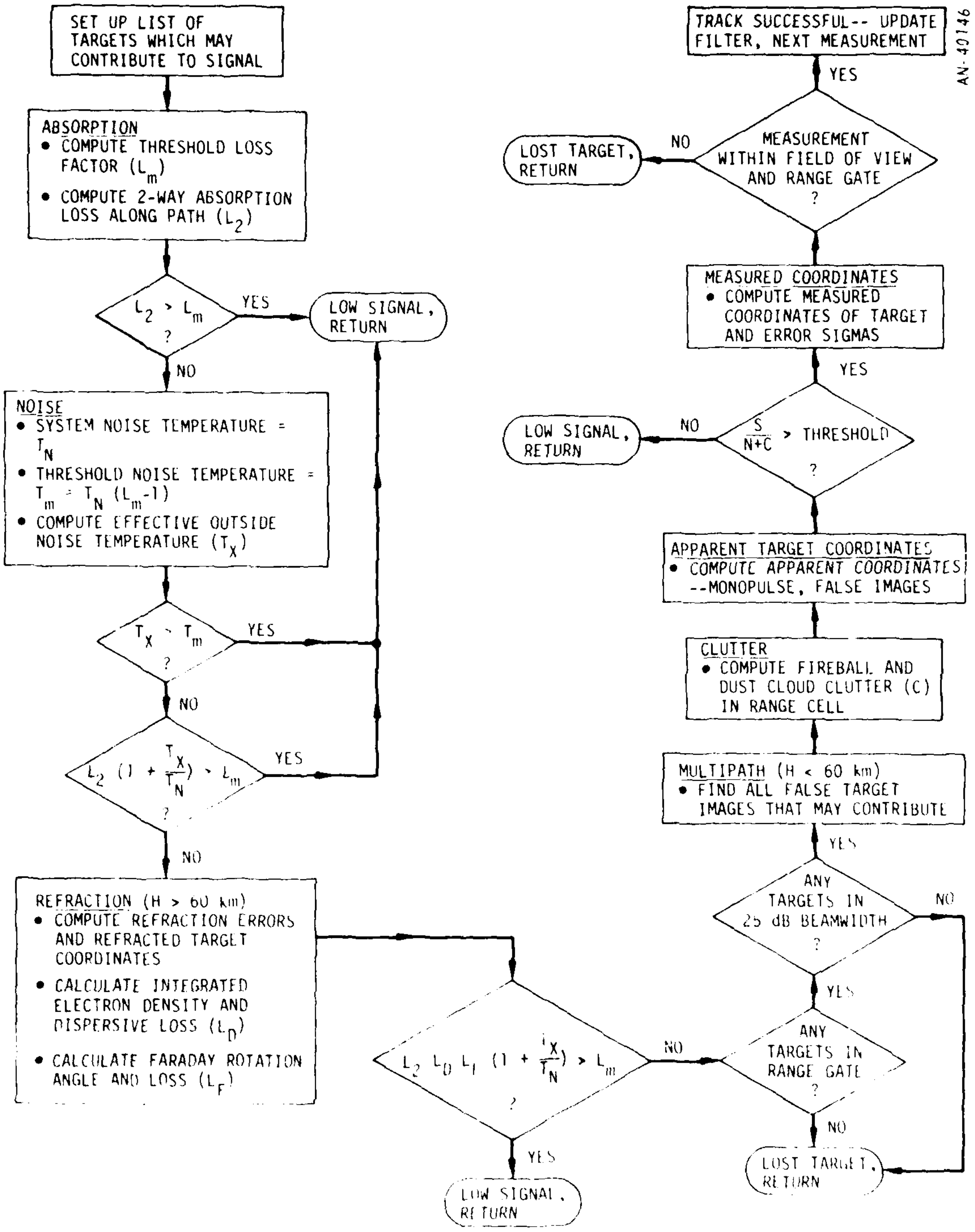

SET UP LIST OF TARGETS WHICH MAY CONTRIBUTE TO SIGNAL
ABSORPTION
• COMPUTE THRESHOLD LOSS FACTOR (L_m)
• COMPUTE 2-WAY ABSORPTION LOSS ALONG PATH (L_2)
$L_2 > L_m$?
YES
LOW SIGNAL, RETURN
NO
NOISE
• SYSTEM NOISE TEMPERATURE = T_N
• THRESHOLD NOISE TEMPERATURE = $T_m = T_N (L_m - 1)$
• COMPUTE EFFECTIVE OUTSIDE NOISE TEMPERATURE (T_X)
$T_X > T_m$?
YES
NO
$L_2 (1 + \frac{T_X}{T_N}) > L_m$?
YES
NO
REFRACTION (H > 60 km)
• COMPUTE REFRACTION ERRORS AND REFRACTED TARGET COORDINATES
• CALCULATE INTEGRATED ELECTRON DENSITY AND DISPERSIVE LOSS (L_D)
• CALCULATE FARADAY ROTATION ANGLE AND LOSS (L_F)
$L_2 L_D L_F (1 + \frac{T_X}{T_N}) > L_m$?
YES
LOW SIGNAL, RETURN
NO
ANY TARGETS IN RANGE GATE ?
NO
LOST TARGET, RETURN
YES
ANY TARGETS IN 25 dB BEAMWIDTH ?
NO
YES
MULTIPATH (H < 60 km)
• FIND ALL FALSE TARGET IMAGES THAT MAY CONTRIBUTE
CLUTTER
• COMPUTE FIREBALL AND DUST CLOUD CLUTTER (C) IN RANGE CELL
APPARENT TARGET COORDINATES
• COMPUTE APPARENT COORDINATES --MONOPULSE, FALSE IMAGES
$\frac{S}{N+C}$ > THRESHOLD ?
NO
LOW SIGNAL, RETURN
YES
MEASURED COORDINATES
• COMPUTE MEASURED COORDINATES OF TARGET AND ERROR SIGMAS
MEASUREMENT WITHIN FIELD OF VIEW AND RANGE GATE ?
NO
LOST TARGET, RETURN
YES
TRACK SUCCESSFUL-- UPDATE FILTER, NEXT MEASUREMENT
AN-40146

Figure 2.7. Radar Signal Processing Logic

1. A list of targets which may contribute to the signal return at this look time is set up by considering a region somewhat larger than the range cell and beamwidth.

2. A threshold loss factor (L_m) which just cancels the incremental target signal above threshold is computed and the two-way absorption loss (L_2) is computed. If the loss (L_2) is greater than the threshold (L_m), processing is terminated and a message signifying the type of failure is returned.

3. Next, the effective outside noise temperature (T_X) is computed and tested against the system noise temperature (T_N). If $T_N > T_X$, the sum of the absorption and noise losses is checked against the threshold loss factor (L_m).

4. If the threshold is not exceeded, refraction due to both gross effects and scintillation is computed and the refracted target coordinates are returned. Losses due to dispersion and Faraday rotation (if a linearly polarized radar signal is used) are also computed. All losses are combined and tested against the threshold. If the target signal is still above threshold, additional tests are made to insure that the refracted target position is in the range gate and 25 dB beamwidth.

5. Next, multipath and clutter are computed to generate the apparent target coordinates.

6. If the signal-to-noise-plus-clutter ratio is still above the threshold, the measurement errors are then added to form the measured target coordinates. At this point, a check is made to determine whether the target is still in the field of view and within the range gate.

7. If it is, a successful track pulse has been made; the data is filtered and a new predicted RV position is created. This information is used to point the radar for the next "look."

Tracking Filter. ROSCOE uses a fully coupled Kalman filter[1] operating with seven state variables (three components of position, three components of velocity, and ballistic coefficient). The input data to the filter may be two-dimensional measurements (e.g., angles-only from an optical sensor), three-dimensional measurements (e.g., R,u,v from a radar), four-dimensional measurements (e.g., $R,u,v,\dot{R}$), or any other suitable set. Any convenient measurement coordinate system can be used; in the present version, all radar measurements are made in radar face coordinates (R,u,v).

An option for exponential memory decay of past measurements is also available. A two-stage scheme for defining the filter decay time constant is used. The user inputs an altitude H_τ , and two values of the decay constant τ_1 and τ_2 . The filter uses τ_1 when the target is above H_τ and τ_2 when the target is below H_τ.

The ROSCOE filter weights the input data in accordance with the estimated measurement error sigmas, but does not apply any special weighting based on assumed environmental conditions. There currently is no provision for "turning off" the filter in response to nuclear bursts.

2.3 THE PHYSICS MODEL

The physics model is divided into two main modules, due to the different treatment given low-altitude and high-altitude phenomenology, plus some general ambient environment routines. A brief description of these modules is given below. See Ref. 2 for a more thorough discussion.

[1] E.R. Buley, Evaluation of MSR Tactical Tracking Filter, July 1971 (unpublished).

[2] J. Ise, A Summary of the ROSCOE Physics Models, General Research Corporation Contract Report (in preparation).

2.3.1 The Ambient Environment

The ambient environment module consists of these major parts:

1. Ambient atmosphere, which returns the state properties of pressure, density, temperature, and scale height and the concentrations of some major species (N_2, O_2, O, He, Ar, CO_2).

2. Minor neutral species, which returns species concentrations for N, NO, $O_2(^1\Delta)$, O_3, NO_2, H_2O, H, OH, HO_2, CO, N_2O, and some excited states.

3. Ambient ionosphere, which returns the effective total ion production rate (Q), the positive atomic ion density, the various positive molecular ion densities, and the electron temperature.

4. Ambient magnetic field, which fits a dipole field to the local magnetic field at a specified central battlespace location and returns magnetic dipole field strength and direction.

2.3.2 The Low-Altitude Model

The low-altitude model encompasses the altitudes from ground to about 90 km. At these altitudes, energy deposition from nuclear bursts tends to be confined to regions near the burst point by the high air density. Thus the properties of the fireball and its immediate surroundings are calculated in detail at each update time, and fireball interactions are considered, but properties in the intervening "continuum" region are treated on a point-by-point basis (when required by the system model), since they may or may not be affected by the bursts.

Fireball Model. The ROSCOE low-altitude fireball model is a "phenomenological" model (as in RANC)[1], in that fireball properties are computed using equations based on physical principles and test data. A number of improvements to the RANC models have been made, including: (1) a tapering

[1] RANC IV, *Computer Simulation of Radar Propagation in a Nuclear Environment*, Vol. I, "Computational Models,"July 1970 (unpublished).

temperature profile from the fireball edge rather than the RANC step-function profile; (2) inclusion of ground-reflected shocks and shock interactions from other fireballs; and (3) multiburst effects, which can result in the merging of two or more bursts into a new one.

The tapering temperature profile has been modeled by first finding the 500°K temperature contour surrounding the fireball shortly after burst (from 2-D hydrodynamic model runs) to define an outer limit of a warm air region (see fig. 2.8). This warm air region is referred to as the "vortex" region, since it is assumed that the vortex motion (if any) that is generated as the fireball rises will be enclosed in this region. It is further assumed for the chemistry calculations that air within this region is thoroughly mixed, that is, particle motion is not followed.

Two kinds of fireball merges can occur. The first is a "hydromerge" where two fireballs are driven together by their hydrodynamic motion to form a larger single fireball. The second type of merge is termed a "radmerge" or radiation merge. In this case, a new burst occurs within an existing one so that the old fireball is given a new pulse of radiation.

Energy Deposition. The principal sources of energy emitted from a low-altitude burst are prompt radiation, thermal radiation, and delayed radiation sources. The prompt radiation sources include neutrons, X-rays, and gammas, and are assumed to deposit an impulse of energy near the burst point that modifies the initial concentrations of electrons, ions, and neutral species.

The major contributors to delayed radiation are neutrons, gammas, and betas. Delayed gammas are deposited outside the fireball. Beta particles can be deposited in a sheath region outside the fireball or in a field-aligned tube (Fig. 2.9). Separate equations are used to determine the beta energy deposited at the various points shown. The sources are summed if the point falls within more than one region (such as point 4).

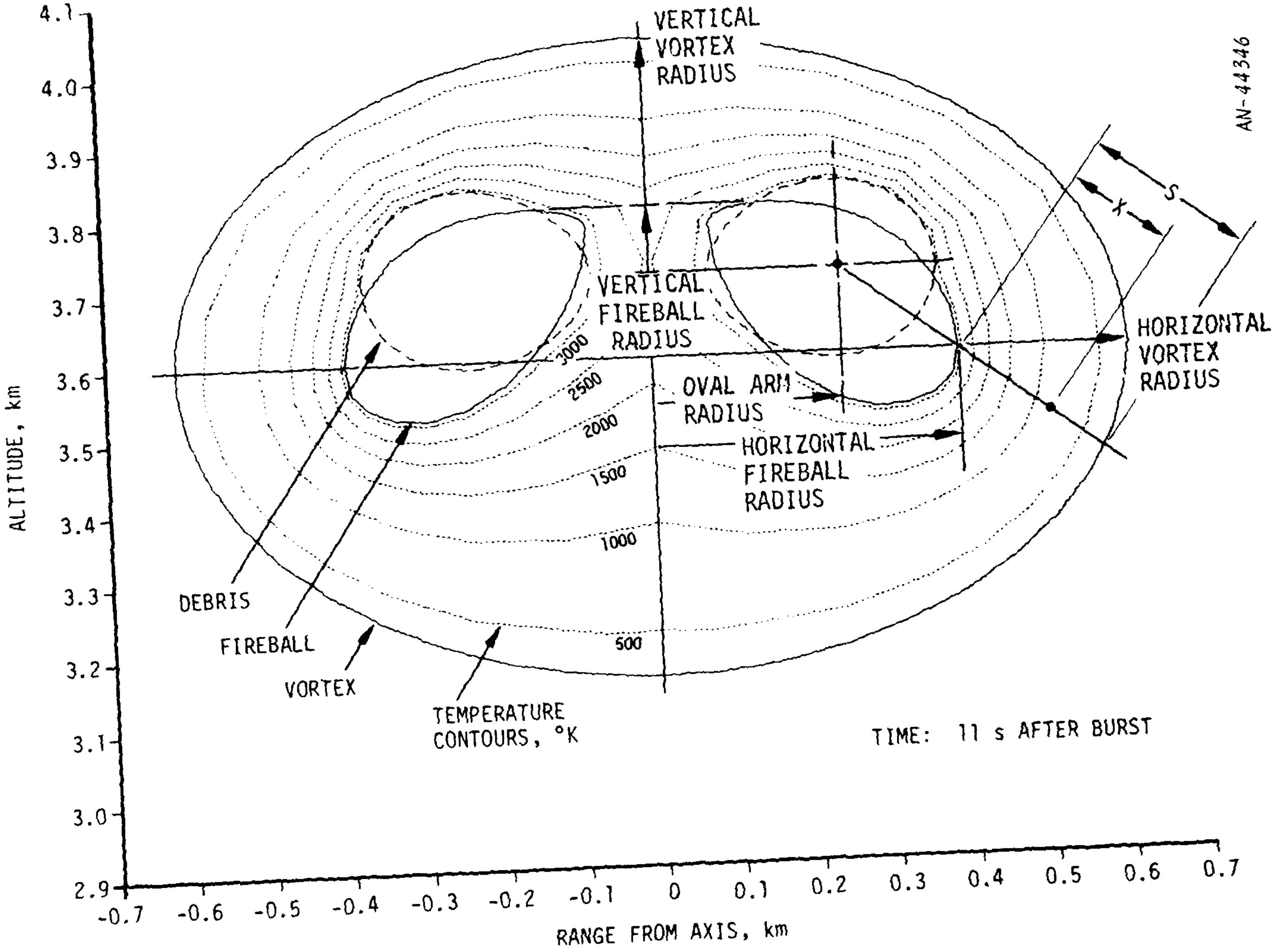


Figure 2.8. ROSCOE Low-Altitude Fireball Example

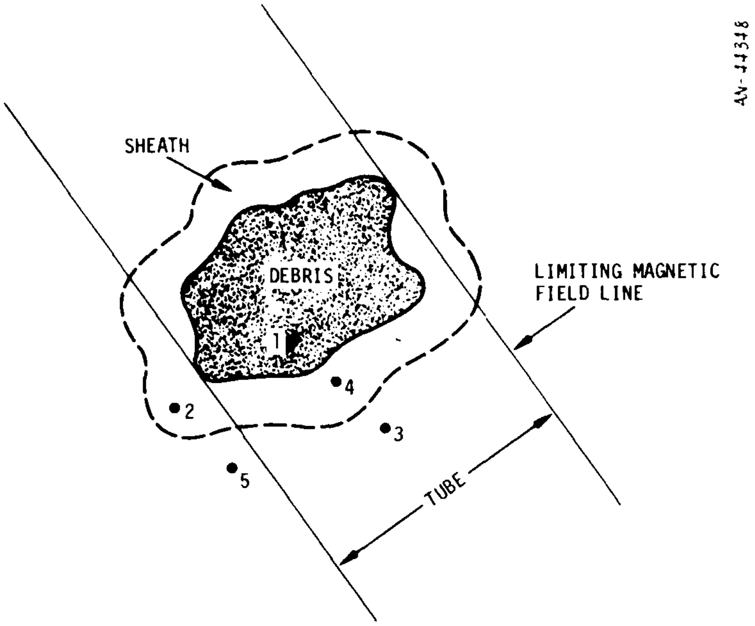


Figure 2.9. ROSCOE Low-Altitude Beta Deposition Regions

The effect of the total delayed radiation reaching a point is determined by summing the energy reaching the point from each burst that occurred prior to the calculation time.

Low-Altitude Chemistry. As mentioned above, air chemistry in the low-altitude module is treated on a point-by-point basis depending on where the point lies with respect to the fireball regions. Four different chemistry regions are considered (Fig. 2.10). A heated-region chemistry routine is used for points inside the vortex where the current temperature is above 500°K and the temperature at burst time was above 2000°K. Recall that although there may be vortex motion in this region, no air motion is considered for the purposes of chemistry calculations.

For points outside the vortex region (termed the "continuum"), a continuum-region chemistry package is called. If the calculation point lies within a few vortex radii of the vortex edge, where an air particle

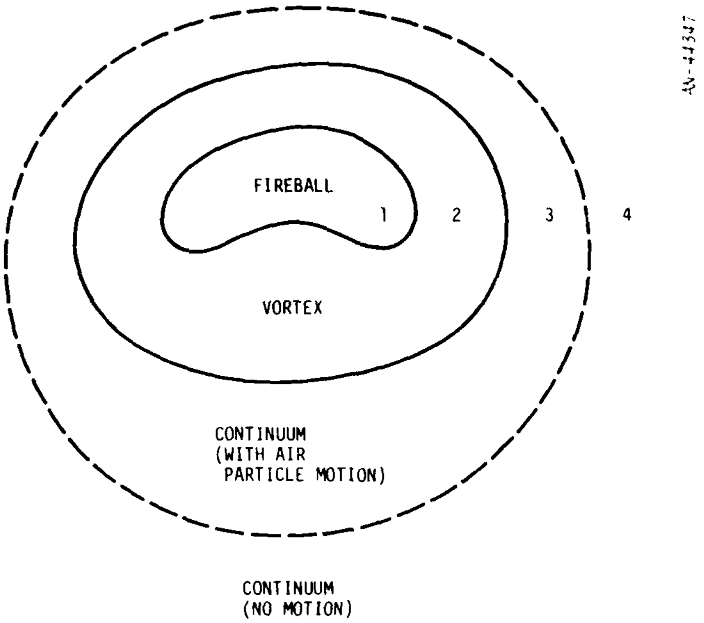


Figure 2.10. ROSCOE Low-Altitude Chemistry Regions

may have been swept up with the fireball, the air particle motion history can be traced to refine the chemistry calculations. This calculation can be time-consuming if there are many closely spaced bursts, so it has been made a program input option.

2.3.3 The High-Altitude Model

The high-altitude model extends from about 90 km up. Here, because of the more rarefied atmosphere, nuclear effects can be widespread. As a result, the high-altitude battlespace is gridded so that air motion and chemistry can be computed in a time-ordered fashion for the entire region. Because there can be many cells in the grid (a maximum of 1300 is currently allowed for) and there are a large number of physical properties to track (currently 33), the grid is updated only periodically and interpolation is used for intermediate times. Update time steps are short immediately after a burst, and longer at later times.[1]

[1] Time steps of 1, 2, 7, 20, 30, 30,...(seconds) are currently used.

Fireball Model. The high-altitude fireball model is essentially the RANC IV model,[1] with some modifications to account for multiburst effects. For example, fireballs born in the grid after a previous burst will be initialized using the disturbed region properties carried in the grid rather than ambient properties.

Fireballs which are formed below the grid and rise into it are currently treated as low-altitude fireballs; that is, their characteristics are still computed by the low-altitude fireball model and the motion of the grid is ignored.

Energy Deposition and Chemistry. At high altitudes, the prompt energy deposition can be widespread. A large module of the code is devoted to depositing the energy from a burst into each cell of the grid. A grid chemistry routine uses the energy deposition to modify the initial ambient concentrations of electrons, ions, and neutral species, and then integrates these properties forward in time to the specified time intervals.

To account for delayed energy deposition at a point, a second chemistry routine is used. The procedure for determining the air chemistry at a point in space and time is to first interpolate the grid properties to obtain the modified air chemistry due to prompt effects, and second (using this set of properties as input) modify the properties again to account for delayed effects.

To obtain the electron density at a point inside a fireball region, the heated-region chemistry routine mentioned earlier must also be called. Then the electron density is set equal to the maximum of either that obtained from the grid chemistry calculation or the heated-region result.

Figure 2.11 is a flow diagram showing the logic described above.

[1] *RANC IV, Computer Simulation of Radar Propagation in a Nuclear Environment*, Vol. [illegible], "Computational Models," July 1970 (unpublished).

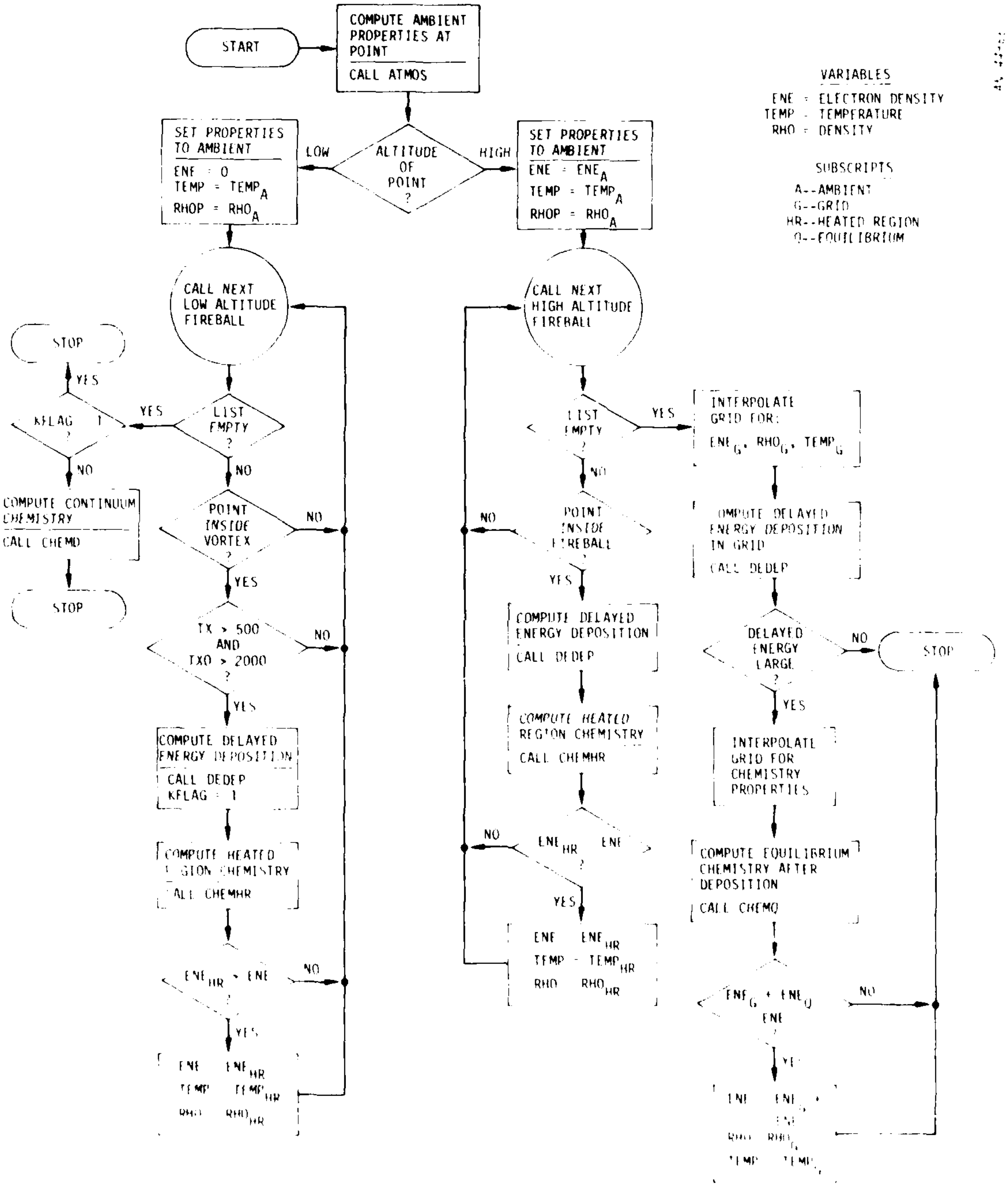


Figure 2.11. ROSCOE Chemistry Calling Logic

Heave Model. A one-dimensional, Lagrangian hydrocode is used to predict particle motion in the grid region. This is done by constructing a grid of tubes at the grid bottom altitude that extends along lines radiating from the center of the earth. One-dimensional air motion in the radial direction is computed for each tube independently as energy is deposited and the air is heated. The tubes can be divided into as many as 18 cells, with cell heights determined from input. Currently, the ROSCOE code uses a cell height which varies with scale height; that is, a finer grid is used at lower altitudes.

A rezoning capability is available as an input option. This allows tubes to be rezoned after significant motion and stretching of cell boundaries has occurred (recall that Lagrangian equations of motion are used, so that cell boundaries are allowed to expand upward as the air is heaved). Rezoning occurs when the top boundary of the uppermost cell in a tube reaches an input altitude (∿650-750 km). The tube is then rezoned by interpolating the data in the existing cells back to the original set of cell boundaries.

Striation Model. A separate ion heave model for predicting striation growth is also available in the code. For this calculation, a plane is set up normal to the magnetic field at a point in the center of the grid. This plane is then divided into a number of rectangles (the number being determined by an input variable), and field-aligned tubes are constructed. The striation routine then interpolates electron density and velocity data from the grid at a number of points along these field-aligned tubes to generate the data base needed for the striation growth and decay computations. A measure of the striation strength is then computed and stored for each rectangular cell in the magnetic planar grid.

The resultant striation fraction (that is, the striation magnitude relative to the background) is then interpolated to find values for each cell in the heave grid, assuming that this striation fraction is constant along field lines.

3 USING ROSCOE

This section of the manual describes the basic program structure, the input data required to run ROSCOE, how the data is to be prepared for input to the program, and the output the program produces.

3.1 PROGRAM ORGANIZATION

The ROSCOE program has been written with two primary objectives in mind. First, ROSCOE must be flexible, both for use and change. It is an all-altitude code, and as such must have the flexibility to provide for many different kinds of scenarios. Second, it must be structured in a modular fashion, so that the effort involved in making changes is minimized. ROSCOE is intended to be a framework within which new phenomenology or systems models can be input with a minimum of effort.

To satisfy these objectives, an event-based structure has been used, in which separate types of calculations are separated into operational overlays, each with its own event. In addition, a modular database structure using the Dynamic Storage Allocation[1] system is used. This allows the database to be placed in a tree structure similar to the code subroutine structure, and separates it from the code so that modules can be replaced without disturbing data interfaces. Finally, a system for structuring the code at run-time (i.e., the capability of selecting alternative models from a large program library) is used so that new or alternative models with similar input/output requirements can be selected for a particular run.

3.1.1 Computational Flow and Storage Organization

The computational flow of the program in its simplest form is shown in Fig. 3.1. The program is an event-type model which internally constructs and updates an event list, orders the events in time, and processes them sequentially. Program termination occurs when there are no more events to be processed.

[1] R.L. Stone, A Dynamic Storage Allocation System for Fortran Programs, General Research Corporation IMR-1249, January 1970.

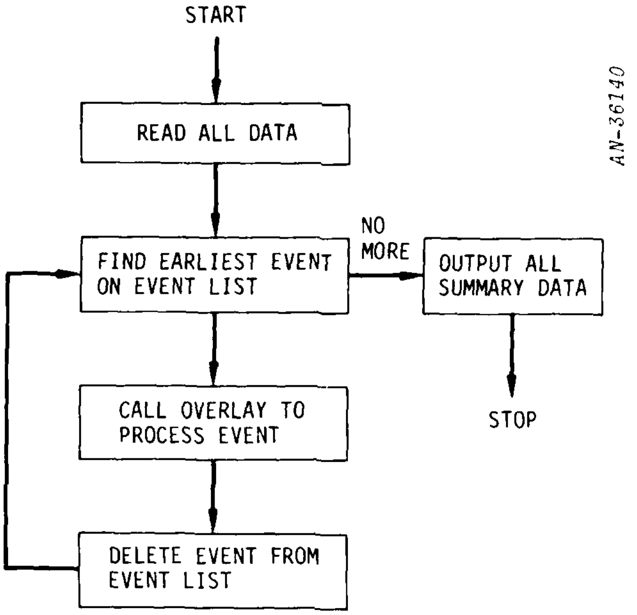

START
READ ALL DATA
FIND EARLIEST EVENT ON EVENT LIST
NO MORE
OUTPUT ALL SUMMARY DATA
STOP
CALL OVERLAY TO PROCESS EVENT
DELETE EVENT FROM EVENT LIST
AN-36140

Figure 3.1. ROSCOE Computation Flow

Figure 3.2 shows the ROSCOE storage organization. The (0,0) overlay contains the main program and the processing routines for dynamic storage allocation (DSA). A block of blank common is reserved for storage of datasets, with a provision for spilling datasets not currently in use onto a random-access storage device.

Overlays (1,0) and (2,0) contain the input and output routines, respectively, and overlay (3,0) the event processor. The lowest level of overlays, (3,1) through (3,32), contain the system and physics modules, each corresponding to a separate event type.

3.1.2 Event Structure

Figure 3.3 is a more detailed look at the event overlays. The event processor accesses events in a time-ordered fashion, as described above. Several of these events are set up in the data deck, including the attack generation event, the burst events, the stop event, the

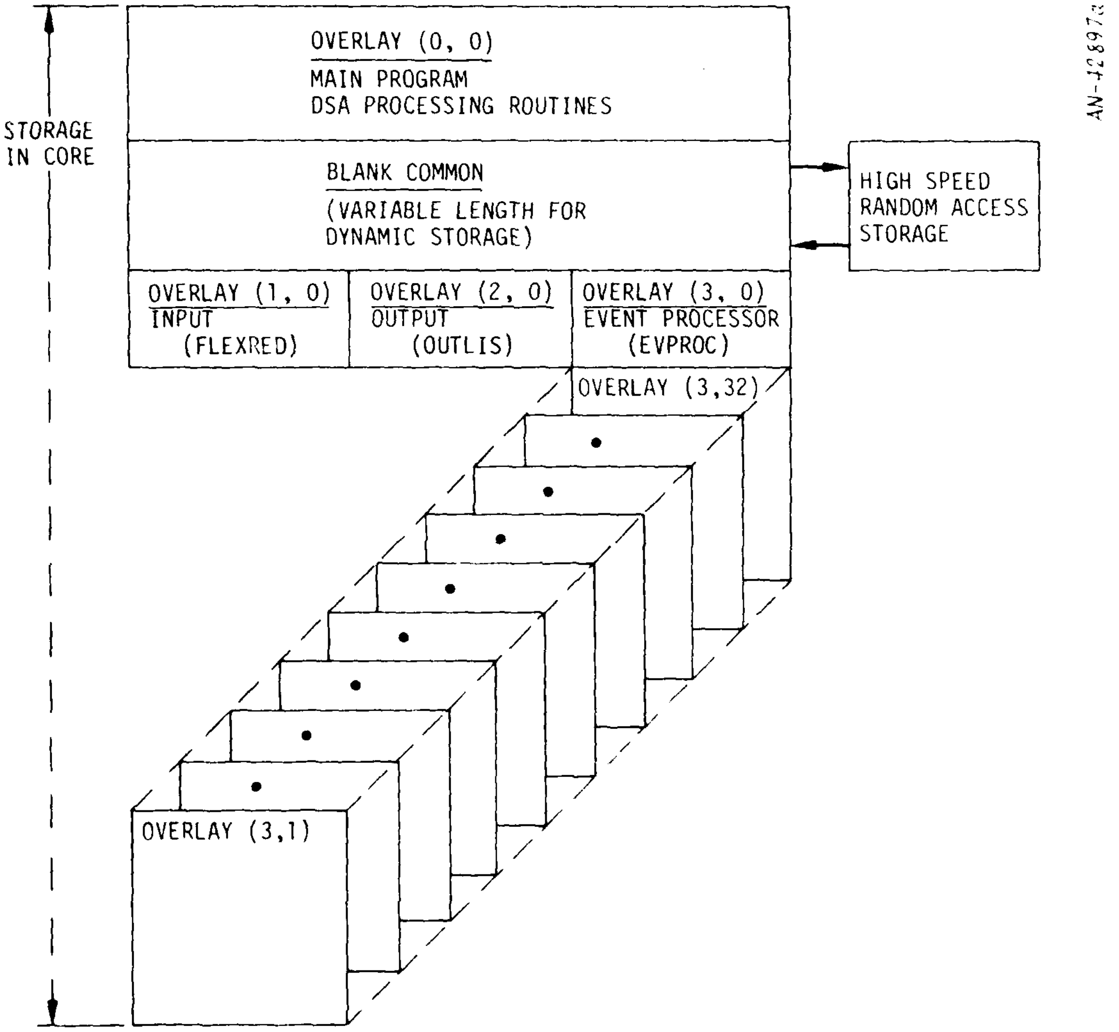


Figure 3.2. ROSCOE Storage Organization

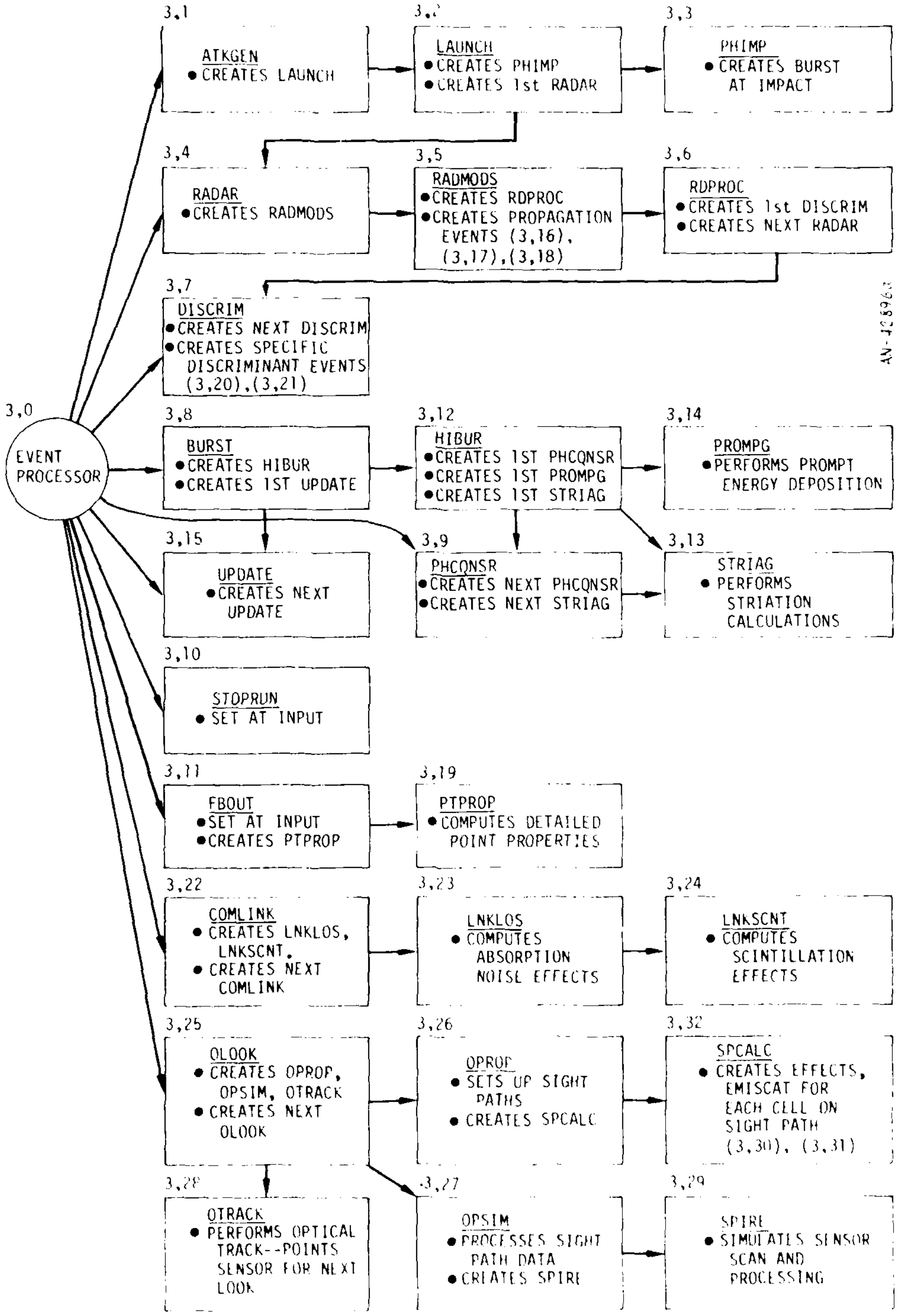


Figure 3.3. ROSCOE Event Structure

communications event, the optics look event, and the environment output event. Others are created by preceding events. For example, the attack generation event creates launch and impact events based on input data. The first radar event (and possibly optics look event) for an object/sensor pair is created by the launch event. The radar event then creates, in succession, the radar propagation events (3,5), (3,16), (3,17), and (3,18), the signal processing event (3,6), and the first discrimination event (3,7), if desired.

The burst event creates the first low-altitude update event (3,15) or a high-altitude burst event (3,12). The high-altitude burst event in turn creates the first high-altitude update event (3,9), the prompt energy deposition event (3,14), and a striation event (3,13). Subsequent physics update events are created within PHCQNSR (3,19) for high-altitude updating, and UPDATE (3,15) for low-altitude updating.

3.1.3 Data Base Organization

There are several ways in which data is transmitted and stored in ROSCOE. First, for very large blocks of data (such as the high-altitude grid data), routines are used to read and write blocks of words directly to peripheral storage. Second, for smaller data blocks internal to specific phenomenology modules, standard labeled common blocks are used so that these modules can be transferred efficiently from ROSCOE to users more familiar with this type of programming. Finally, for small data blocks used in the systems portion of the code and some of the physics interface structure, a data structure based on the Dynamic Storage Allocation[1] system is used. The first two means of handling data are well known, but the DSA system is less standard and deserves fuller discussion.

The original intent of the DSA system was to provide a system of utility routines for data management so that the programmer who was using the system saw the machine as having an infinate "virtual memory"

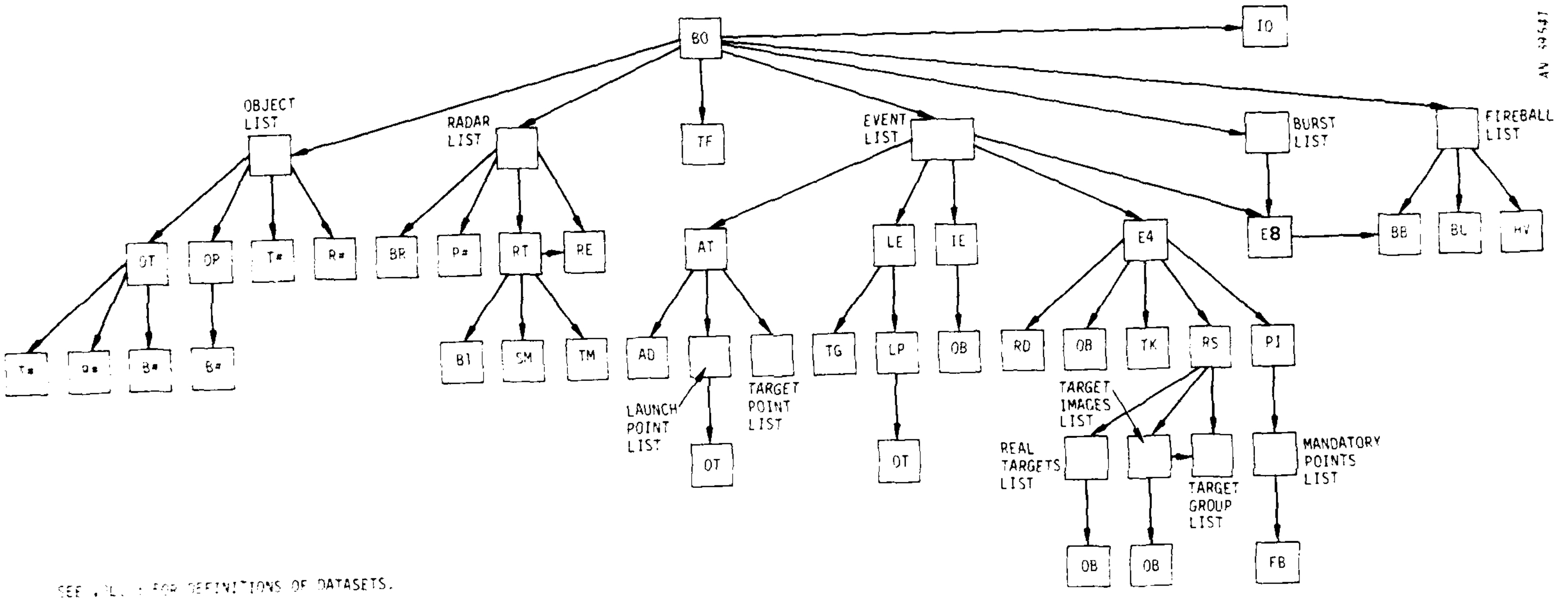
[1] R.L. Stone, A Dynamic Storage Allocation System for Fortran Programs, General Research Corporation IMR-1249, January 1970.

for data storage. Rather than the usual organization of data into large multiply-dimensioned arrays, which are accessed by means of indexing and searched by means of the Fortran DO-loop, data in the DSA mode ot operation is organized into individual datasets, which are relatively short (the maximum length tends to be a few tens of words), and which are organized into lists. System subroutines are then provided to enable the programmer to search a given list, to access a dataset whose identity is known, and in general to perform all the operations on datasets that can be performed on the more standard dimensioned arrays. Two new kinds of data words have been defined: the List Header Variable (LHV), and the Data Set Pointer (DSP), which serve the functions, respectively, of identifying a list, thus enabling the program to access its members, and of identifying an individual dataset, thus enabling the program to access that dataset.

This capability allows the model designer to put together extremely complex data structures without making use of large arrays. For example, the dataset describing an event such as a radar track pulse would contain pointers to a list of the radar's faces (for a multi-faced array), and to a radar type dataset which contains power, frequency, angular limits, and the like, which are common to several radars. Generally this radar-type dataset does not tell how many radars are of this type--perhaps none are, perhaps all but one, or perhaps all of them. Thus a simulation is possible in which all radars are different, all the same, or any mixture. The actual scenario being simulated is determined by the data structure, which is in turn input via a DSA subroutine (FLEXRED)[7] which is designed for the input of complex DSA structures. Thus, the programmer is relieved of the necessity of setting up the data structure--this is done at execution time as part of the data input process; data items may be added or deleted, and the data organization changed, without having to make any changes in the code.

Figure 3.4 shows a portion of the DSA data base structure. Each dataset is identified by a two-character mnemonic. For example, the "basic" dataset is identified by the letter and number B0. Each event

[1] J.A. Bardens and L.R. Ford, FLEXRED Users Manual, General Research Corporation RM-1447, August 1972.



SEE [illegible] FOR DEFINITIONS OF DATASETS.

Figure 3.4. Dataset Structure

has a corresponding dataset; for example, the burst event dataset is denoted by E8. Every dataset is tied tó the basic dataset along with some important lists such as the object list, the radar list, and the burst list. Datasets containing more detailed information, such as object type, radar type, and weapon type information, emanate from these main datasets and lists.

With the above data base tree structure, any subroutine having the basic dataset can access lower-level information by use of the pointers and list headers.

3.2 PROGRAM INPUT/OUTPUT

Flexible input/output routines (FLEXRED, SIMPLFY and OUTLIS) designed to be used with DSA have been incorporated in ROSCOE. The use of the FLEXRED routine allows one to build quite complicated data structures, while OUTLIS allows the creation of output lists, printer plots, or Calcomp plots through data input at run time.

SIMPLFY is a much simpler input scheme than FLEXRED. It allows most problems to be run but with some limitations on the number of items (objects, sensors, bursts) considered. It was written for the casual ROSCOE user and is documented in a separate report.[1]

To explain the usefulness of FLEXRED and OUTLIS, descriptions of the use of these routines are given below. These discussions are followed by a description of the specific ROSCOE inputs.

Sample output form the code is given in Volume 2.

3.2.1 FLEXRED

3.2.1.1 Inputs of "Traditional Data"

This section describes the options open to the user in inputting

[1] J. Baltes and J. Garbarino, A Simplified ROSCOE Input Scheme General Research Corporation, December 1979.

data of a standard FORTRAN type (fixed point, floating point, or Hollerith). Also, the automatic scaling and coordinate transformation features are described.

FLEXRED places input data words consecutively into whatever dataset it is processing until it is given a command to do otherwise. That is, it will build up a dataset until told to start a new dataset or some other command occurs which stops construction of the current dataset. Thus it builds datasets linearly by default.

A FLEXRED input card is divided into eight 10-column fields. The last of these (71-80) is generally reserved for instructions to FLEXRED, i.e., a card type identifier. All data fields start in the fifth field (41-50) except when the amount of data on the card (the TABLE and the VECTOR cards) requires use of the fourth field as well. All fields to the left of the first-used data field are free for user comments and descriptive matter.

Automatic Unit Conversion and the SCALE Card. The internal units assumed by FLEXRED are MKS units; its geographical coordinate system is earth-fixed cartesian; its angles are measured in radians. Automatic unit conversion is provided for many of the commoner units; in addition, the user may define or redefine his own units by means of the SCALE card.[1] Table 3.1 lists the built-in units which will be recognized by the system. Input values identified by the characters in the "unit name" column will be multiplied by the associated factor to effect the conversion to the MKS-radians internal units. Note that DB (or DBSM) and INT (or INTEGER) do not, properly speaking, represent scaling factors, but rather built-in functions.

The user may expand or edit the list of "standard" units shown in Table 3.1 by means of the SCALE card.

The SCALE card (see Fig. 3.5) is used to define scaling factors other than those provided by the system. It may also be used to redefine

[1] In ROSCOE, internal calculations are in CGS units; thus a set of SCALE cards are used to convert from normal FLEXRED units.

TABLE 3.1

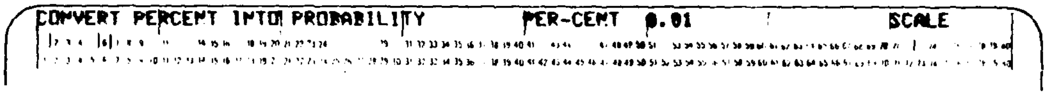
UNIT NAMES RECOGNIZED BY FLEXRED

Unit Name	Unit	Factor for Conversion to MKS-Radians
DEG	degrees	0.01745329252
FT	feet	0.3048006
PSF	pounds per square foot	4.88240
KM	kilometers	1000.0
NMI	nautical miles	1853.25
LB	pounds	0.453592
G	gravity	9.80665
KFT	kilofeet	304.8006
M	meters	*
MRAD	milliradians	0.001
SEC	seconds	*
DB or DBSM[†]	decibel referred to 1 square meter	$xDB \rightarrow 10^{x/10}$
INT or INTEGER		Fixed point input--converted from floating point

[*] M and SEC are provided for the user's convenience in documenting his input deck; they do not cause any conversion and may be omitted.

[†] DBSM cannot be used correctly in the current version of ROSCOE since internal units are in the CGS system; however, DB, which is inherently dimensionless, remains legitimate.

values for system-provided scaling constants (except for DB, DBSM, and INT or INTEGER, due to their unique status as functions). Columns 1-40 are reserved for user comments, the alphabetic name of the unit is defined starting in 41, the numerical scaling factor in the field 51-60, and the word SCALE starting in 71. The example shown in Fig. 3.5 would ensure that input data identified as PER-CENT would be converted to statistical probability values by a factor of 0.01.



```
CONVERT PERCENT INTO PROBABILITY          PER-CENT  Ø.01                SCALE
```

Figure 3.5. Example of a SCALE Card

The SCALE card may appear anywhere in the data deck, provided that it appears prior to the first use of the defined unit.

Primary Data Input, Tables, and Vectors. Numeric data may be entered into a dataset either singly, in pairs using the TABLE card, or in triples using the VECTOR card. Data is always stored in floating point format, unless INT or INTEGER is used in the unit-name field, or unless the data is recognized as Hollerith (see "Hollerith Data Input"). An example is given in Fig. 3.6.

It is important to remember that the words of a particular dataset are filled sequentially, so that a VECTOR card, for example, fills three of them. A similar remark applies to the geographical inputs discussed under "Geographical and Related Inputs."

The data input format is somewhat freer than standard FORTRAN rules: Blanks act as delimiters for the data field, and decimal points need not be punched after whole numbers. A few examples will make this clear, as in Fig. 3.7.

Note that the 10-character field is processed from left to right. This discussion applies to all numeric data fields used by FLEXRED.

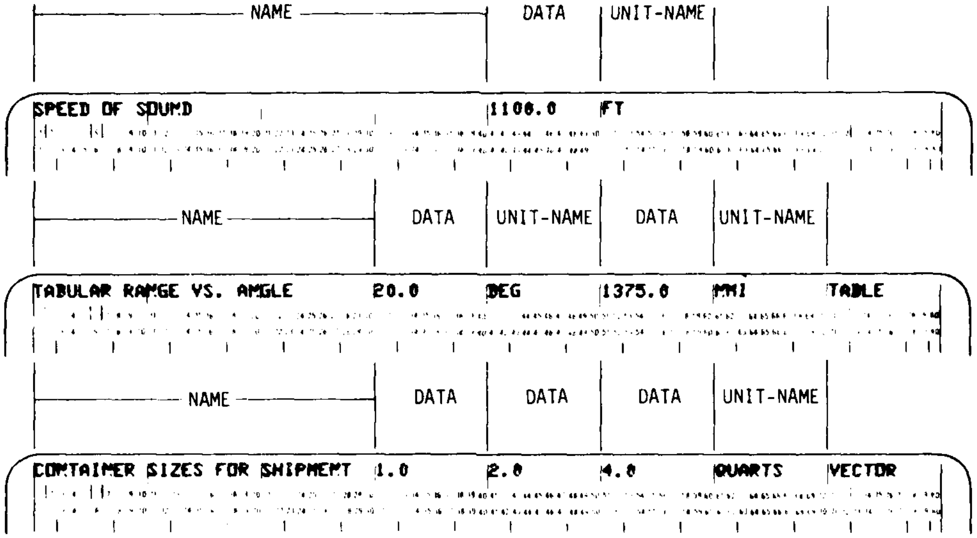


Figure 3.6. Examples of Numeric Input

PUNCHED (COLUMNS)										PRODUCES
1	2	3	4	5	6	7	8	9	10	
		-	3							-3.0
		5	.	7	E	3		5		5.7 x 10^3
		-	3	8	7	5				-3875.0
		-		5	.	7				0.0*
+	1	5	.	5						15.5
										0.0**
	.	7	2	3						.723

*The minus is accepted as a valid numeric character, but the following blank terminates the field, causing interpretation as 0.0.

**An all-blank field is interpreted as 0.0.

Figure 3.7. Sample Data Values

If a dataset requires several consecutive zero words, perhaps to be used later by the program, these may be provided by the ZEROS card. Columns 41-50 contain a number (the number of words of zeros desired) and the word ZEROS appears in column 71-80. For example, the card shown in Fig. 3.8 will produce 10 consecutive zero words in the dataset containing it.

Geographical and Related Inputs. A series of card types is provided for automatic conversion of geographical inputs, and for inputs relative to a prescribed geographical location.

The coordinate system used internally is earth-centered earth-fixed Cartesian with the North Pole lying on the positive z-axis and the point where the Greenwich meridian crosses the equator lying on the positive x-axis. The right-handed system is completed by a y-axis which points out into the Indian Ocean. Longitude is reckoned positive to the East and negative to the West, which makes it conform to the customary convention for the θ of spherical coordinates. Altitude is measured from a sea-level radius of 6,375,180.0 meters.

The fundamental geographical position input card is the GEOGR card. Its format is seen in Fig. 3.9. Columns 1-40 are for user comments; 41-50

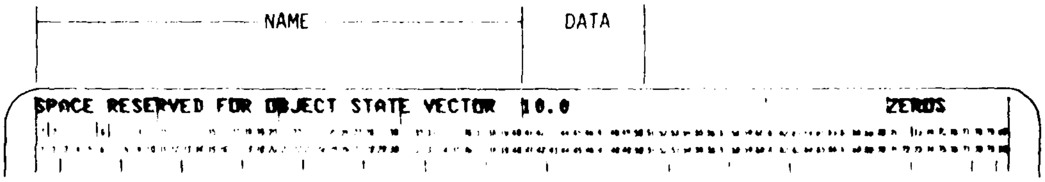
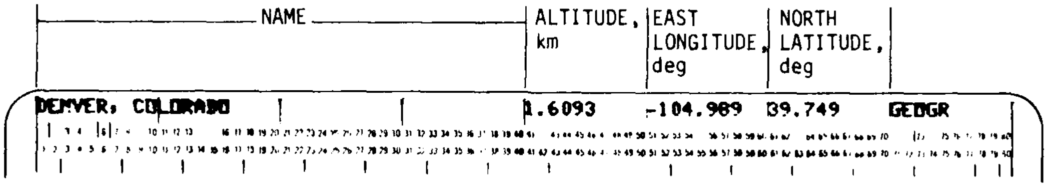


Figure 3.8. The ZEROS Card



NAME	ALTITUDE, km	EAST LONGITUDE, deg	NORTH LATITUDE, deg	
DENVER, COLORADO	1.6093	-104.989	39.749	GEOGR

Figure 3.9. GEOGR Card

contain the altitude in kilometers; 51-60 the longitude in degrees; 61-70 the latitude in degrees; and the word GEOGR starts in column 71.

Conversion to the fundamental Cartesian coordinates is accomplished automatically, units being governed by the current values of scaling associated with KM and DEG.

There are four additional cards which define geometrical inputs relative to the last previously read GEOGR card. These require a little preliminary discussion and definition. In Fig. 3.10, G denotes the location of the last GEOGR point, and the pictured plane is the tangent plane at G . Another location, P , may then be defined by specifying its location relative to G , e.g., by its range, azimuth, and elevation as seen from G . It should be noted that "azimuth" is measured counter-clockwise from East (θ of plane polar coordinates).

The four "relative to GEOGR" cards are shown in Table 3.2. Columns 1-40 are free for user comments.

Although the POLAR and RADAR cards appear at first glance to be the same, the reader should note that the vector returned for POLAR is measured from G (see Fig. 3.10), whereas for RADAR the vector returned is measured from the center of the earth, C.

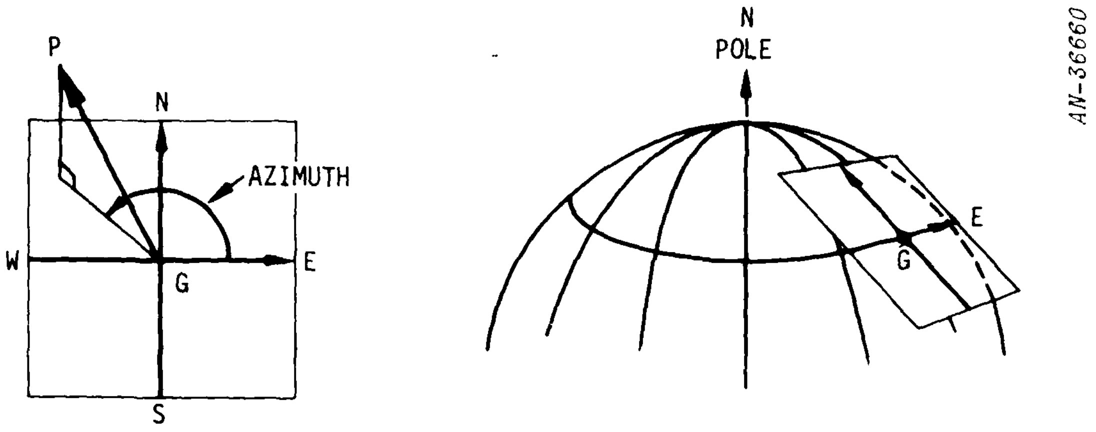


Figure 3.10. The Local Coordinate System

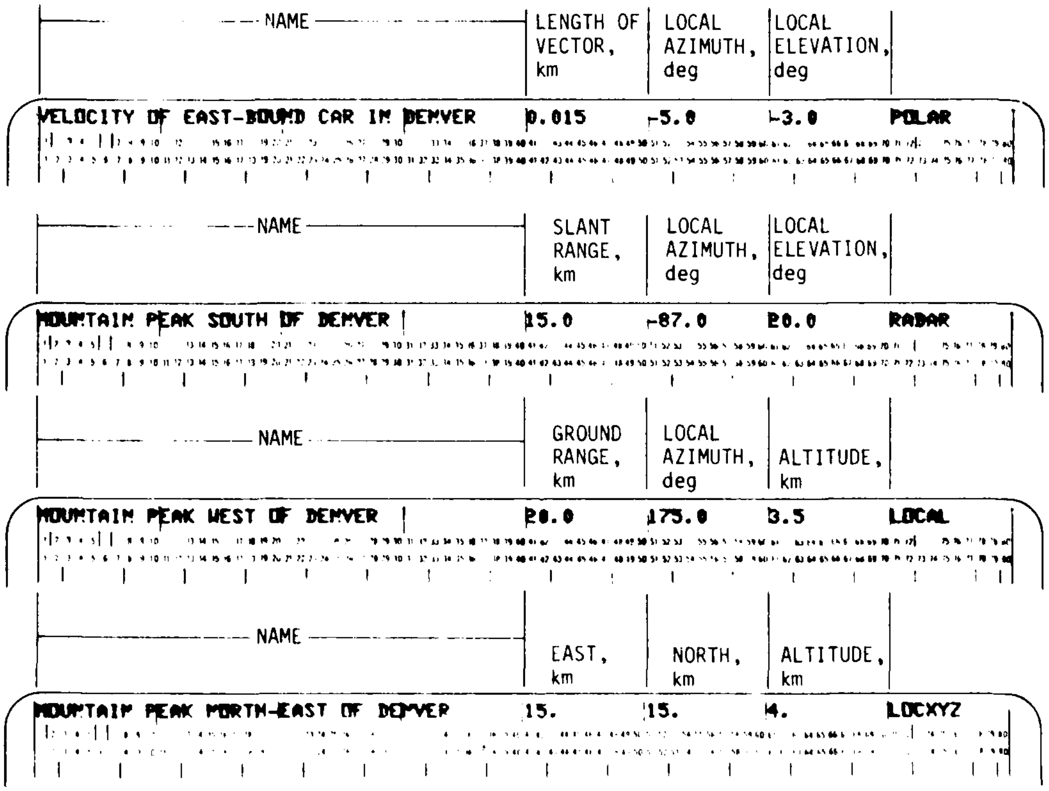
TABLE 3.2

THE "RELATIVE" CARDS

Card Name (Column 71)	Column 41	Column 51	Column 61	Cartesian Vector Stored Within Dataset Being Processed
POLAR	Vector length, km	Azimuth, deg	Elevation, deg	$\overrightarrow{GP}$
RADAR	Slant range, km	Azimuth, deg	Elevation, deg	$\overrightarrow{CP}$
LOCAL	Ground range, km	Azimuth, deg	Altitude, km	$\overrightarrow{CP}$
LOCXYZ	East, km	North, km	Distance (km) above tangent plane	$\overrightarrow{CP}$

Examples are given in Fig. 3.11. The POLAR vector is typically a short vector, such as a direction or a velocity, described in locally defined reference terms, whereas the RADAR, LOCAL, and LOCXYZ vectors are typically position vectors measured in the earth-centered system.

Hollerith Data Input. When using the single-word data input option, the input data in columns 41-50 will be treated as Hollerith data and read in A10 format whenever FLEXRED is not able to identify it as a number



NAME	LENGTH OF VECTOR, km	LOCAL AZIMUTH, deg	LOCAL ELEVATION, deg	
VELOCITY OF EAST-BOUND CAR IN DENVER	0.015	-5.0	-3.0	POLAR

NAME	SLANT RANGE, km	LOCAL AZIMUTH, deg	LOCAL ELEVATION, deg	
MOUNTAIN PEAK SOUTH OF DENVER	15.0	-87.0	20.0	RADAR

NAME	GROUND RANGE, km	LOCAL AZIMUTH, deg	ALTITUDE, km	
MOUNTAIN PEAK WEST OF DENVER	20.0	175.0	3.5	LOCAL

NAME	EAST, km	NORTH, km	ALTITUDE, km	
MOUNTAIN PEAK NORTH-EAST OF DENVER	15.	15.	4.	LOCXYZ

Figure 3.11. Examples of the "Relative" Cards. (These examples assume that the last-read GEOGR card was that of Fig. 3.9.)

according to the rules illustrated in Fig. 3.7. An example is shown in Fig. 3.12.

The FORMAT Card. This card allows the user to read in quantities of data from cards in his own format. This card has two forms (see Fig. 3.13). The program assumes that the number of cards is one unless it can identify some number different from 1 in the field of columns 21-30.

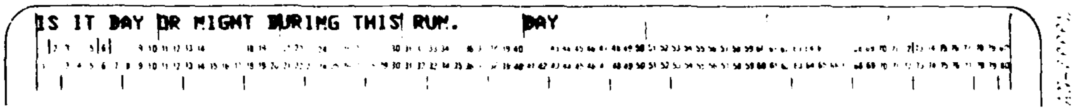
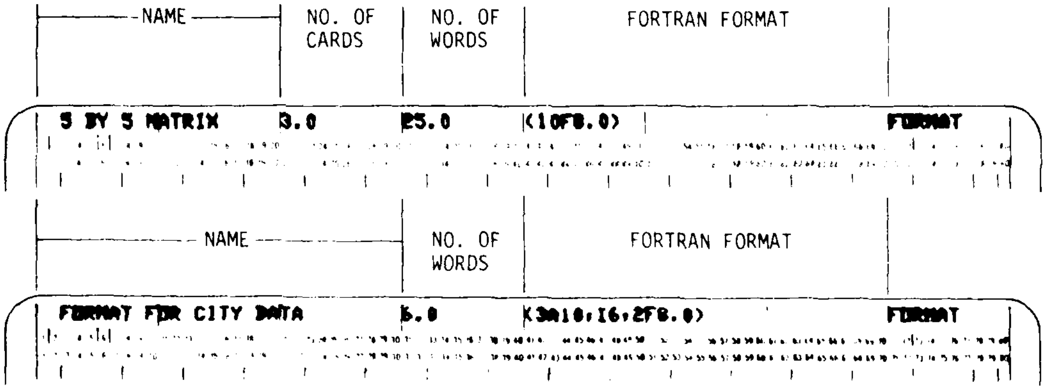


Figure 3.12. Example of Hollerith Input



(NO. OF CARDS ASSUMED TO BE 1)

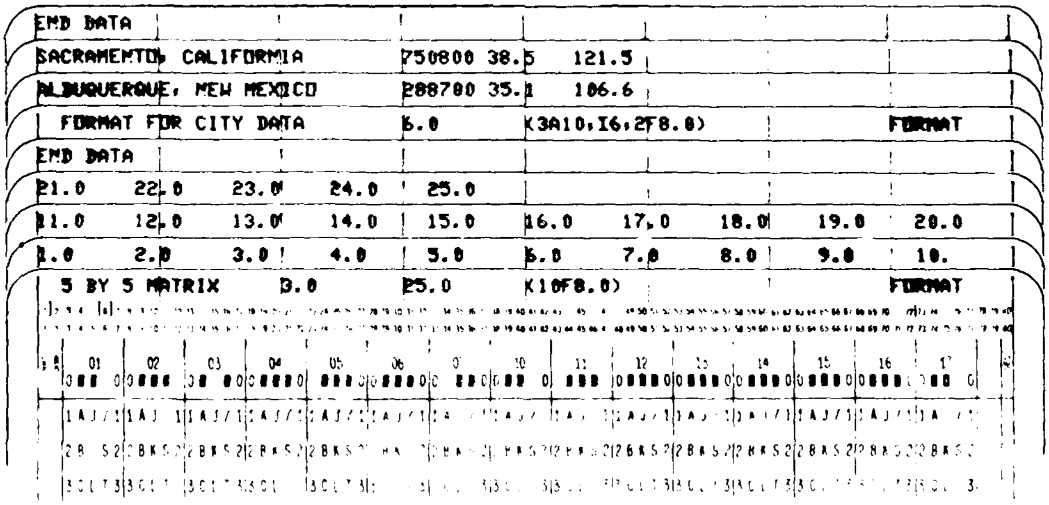
Figure 3.13. The FORMAT Card

Once a FORMAT card has been identified and the number of cards (n) and the number of words (m) have been defined, the program reads m words from the next n cards using the standard Fortran format provided in field 41-70. It will then read a second batch of m words from the next succeeding n cards, and so on. This flow of data is terminated by a card with END DATA beginning in column 1.

In the examples shown in Fig. 3.14, 25 words will be read by the first format and 12 words will be read by the second.

It should be noted that when the FORMAT card is used, the numerical inputs are generated strictly by FORTRAN conversion rules. That is, the conventions of Fig. 3.7 do not apply, and illegal punches will cause premature program termination.

CARDS ARE TO BE READ FROM BOTTOM TO TOP



```
END DATA
SACRAMENTO, CALIFORNIA              750800 38.5    121.5
ALBUQUERQUE, NEW MEXICO             288700 35.1    106.6
  FORMAT FOR CITY DATA              6.0           (3A10,I6,2F8.0)                    FORMAT
END DATA
21.0      22.0      23.0      24.0      25.0
11.0      12.0      13.0      14.0      15.0      16.0      17.0      18.0      19.0      20.0
1.0       2.0       3.0       4.0       5.0       6.0       7.0       8.0       9.0       10.
  5 BY 5 MATRIX       3.0           25.0          (10F8.0)                           FORMAT
```

Figure 3.14. Use of FORMAT Card

3.2.1.2 Structuring of the Data System

A data structure for a DSA-based program consists of datasets and lists of datasets. (A list is a collection of datasets which are logically associated in some manner. The word "file" is sometimes used synonymously with "list.") Associated with each dataset and list is a data word (the dataset pointer, DSP, in the case of a dataset and the list header variable, LHV, in the case of a list) which allows the user to obtain access to the contents of the dataset or list.

The FLEXRED program provides a method for creating both datasets and lists, and for storing as data both the DSP word addresses and the LHVs associated with them.

Structuring of Datasets. A dataset is defined by a BEG SET card. The dataset is identified (for FLEXRED purposes only) by the first 40 characters on the BEG SET card. It contains data in the amounts and in the order specified by ensuing data cards in sequence, terminated by an END SET card or by the beginning of another dataset or list (a BEG SET or a BEG LIST card).

The example in Fig. 3.15 defines a dataset with seven words in it. It has an identification for FLEXRED purposes which is:

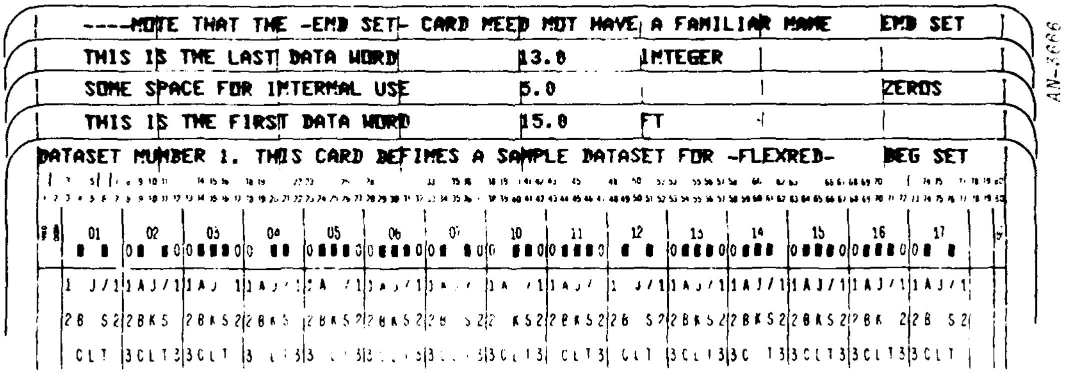
DATASET NUMBER 1. THIS CARD DEFINES A SA

and which may be used later to refer to the dataset.

Once a dataset has been created, it may then be used in three different ways.

1. The DSP word address of the dataset may be stored as a piece of data in another dataset. This is done by means of the REFER card. The dataset may then be accessed by a call to DSA subroutine INDWRD or

CARDS ARE TO BE READ FROM BOTTOM TO TOP



```
----NOTE THAT THE -END SET- CARD NEED NOT HAVE A FAMILIAR NAME    END SET
THIS IS THE LAST DATA WORD             13.0     INTEGER
SOME SPACE FOR INTERNAL USE            5.0                        ZEROS
THIS IS THE FIRST DATA WORD            15.0     FT
DATASET NUMBER 1. THIS CARD DEFINES A SAMPLE DATASET FOR -FLEXRED-    BEG SET
```

Figure 3.15. A Sample Dataset Containing Seven Words of Data

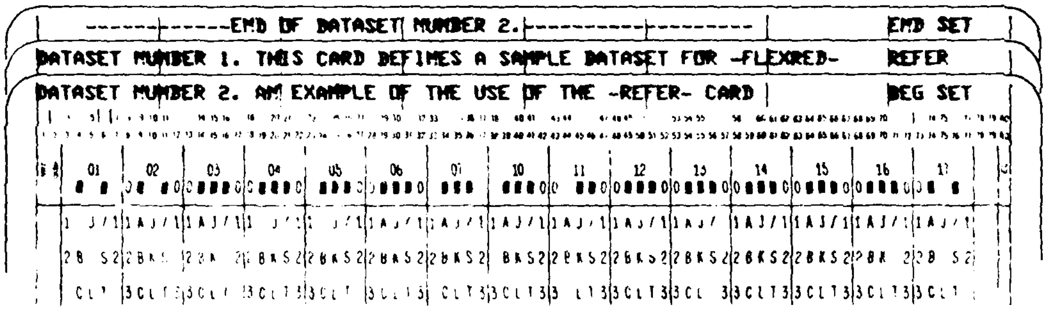
INDWRL. Figure 3.16 shows an example, where a dataset is defined containing one data word, which is the DSP word address of the dataset defined in Fig. 3.15. The effect of the REFER option here is to place a pointer to one dataset within another.

2. A copy of the complete dataset may be incorporated as part of another dataset. This is done by means of the INSERT card. Figure 3.17 shows the construction of an eight-word dataset containing the combined data of the datasets of Figs. 3.15 and 3.16.

3. The dataset may be added to a list. This is also done by means of the REFER card, as discussed below.

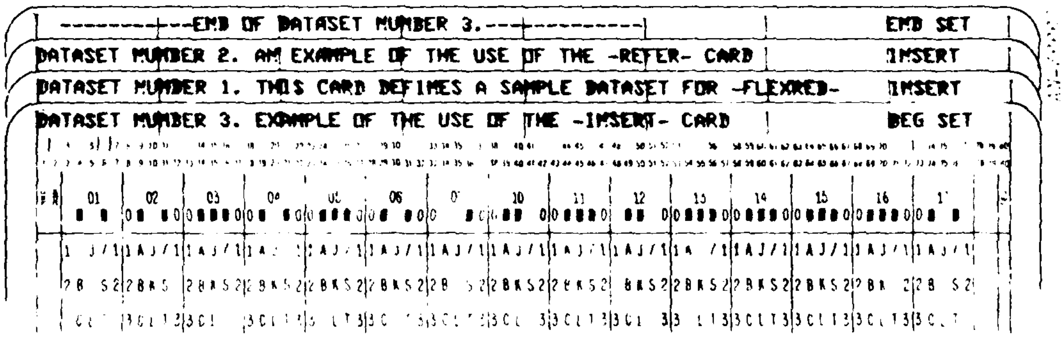
Structuring of Lists. A list is defined by a BEG LIST card. The list is identified (for FLEXRED purposes only) by the first 40 characters on the BEG LIST card. Datasets appear on the list in the exact

CARDS ARE TO BE READ FROM BOTTOM TO TOP



```
-------+-----END OF DATASET NUMBER 2.+----------+---------        END SET
DATASET NUMBER 1. THIS CARD DEFINES A SAMPLE DATASET FOR -FLEXRED-  REFER
DATASET NUMBER 2. AN EXAMPLE OF THE USE OF THE -REFER- CARD        BEG SET
```

Figure 3.16. Use of the REFER Card to Produce a DSP Word Address



```
---------+---END OF DATASET NUMBER 3.---+-----------              END SET
DATASET NUMBER 2. AN EXAMPLE OF THE USE OF THE -REFER- CARD        INSERT
DATASET NUMBER 1. THIS CARD DEFINES A SAMPLE DATASET FOR -FLEXRED- INSERT
DATASET NUMBER 3. EXAMPLE OF THE USE OF THE -INSERT- CARD          BEG SET
```

Figure 3.17. Use of the INSERT Card to Produce Composite Datasets

order specified by the ensuing REFER cards in sequence, and the list is terminated by an END LIST card or by the beginning of another list or dataset (a BEG SET or a BEG LIST card).

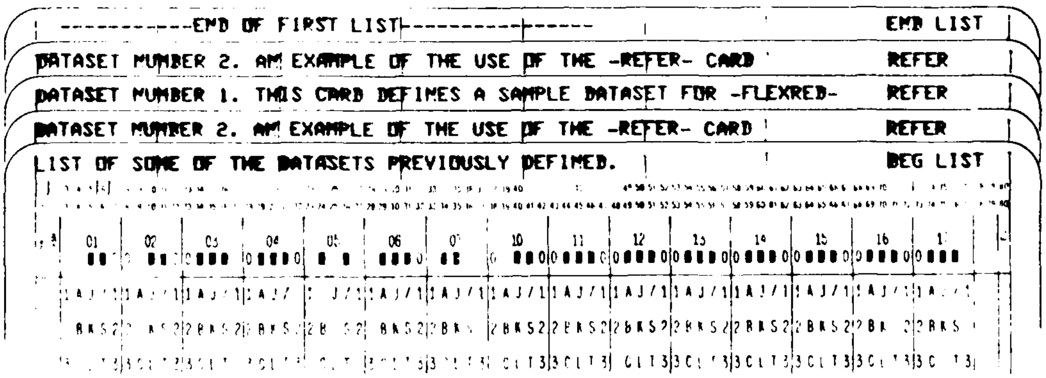
The example in Fig. 3.18 defines a list with three datasets on it (the first and third happen to be the same dataset--this is not an error, as the datasets on a list are not required to be distinct). The identification of this list for FLEXRED purposes is

LIST OF SOME OF THE DATASETS PREVIOUSLY

which may be used later to refer to the list.

Once a list has been created, it may then be used in two different ways.

CARDS ARE TO BE READ FROM BOTTOM TO TOP



```
------------END OF FIRST LIST----------------                END LIST
DATASET NUMBER 2. AN EXAMPLE OF THE USE OF THE -REFER- CARD    REFER
DATASET NUMBER 1. THIS CARD DEFINES A SAMPLE DATASET FOR -FLEXRED-   REFER
DATASET NUMBER 2. AN EXAMPLE OF THE USE OF THE -REFER- CARD    REFER
LIST OF SOME OF THE DATASETS PREVIOUSLY DEFINED.               BEG LIST
```

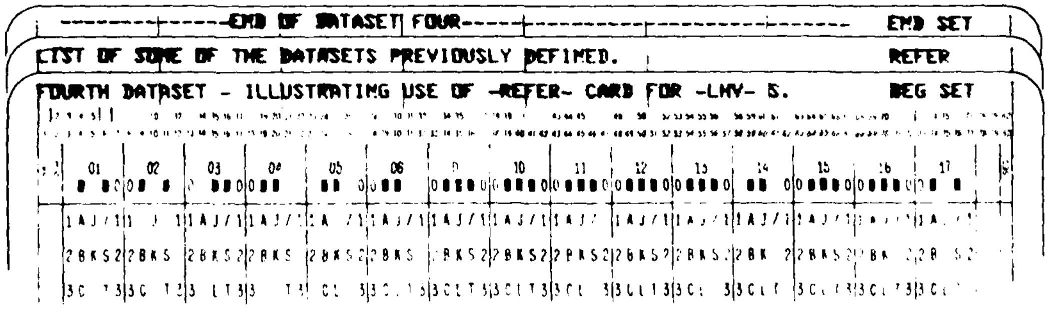
Figure 3.18. A Sample List Containing Three Datasets

1. Its list header variable (LHV) may be stored as a piece of data in some dataset. This is done by using the REFER card, with the list name on it. An example will be seen in Fig. 3.19 where a one-word dataset has been created whose contents are the LHV for the list defined in Fig. 3.18.

2. A copy of it may be incorporated as part of another list. This is done by means of the INSERT card. Figure 3.20 shows the construction of a list containing six datasets (counting repetitions, of course) formed from the list of Fig. 3.18 by using the INSERT card.

The uses of the REFER and INSERT cards are summarized in Table 3.3. It should be noted again that the order of presentation of the data is only important during the definition of a list or dataset. The lists and datasets themselves may appear in any order and need not have appeared prior to their use on a REFER or INSERT card. Use of the INSERT card, however, may lead to a logical paradox (such as INSERTing an entity into

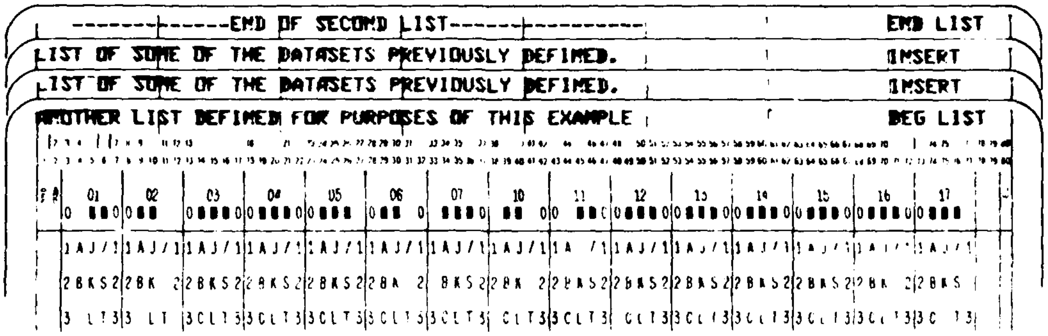
CARDS ARE TO BE READ FROM BOTTOM TO TOP



```
--------+-----END OF DATASET FOUR-----+---------+---------+------   END SET
LIST OF SOME OF THE DATASETS PREVIOUSLY DEFINED.                    REFER
FOURTH DATASET - ILLUSTRATING USE OF -REFER- CARD FOR -LHV- S.      BEG SET
```

Figure 3.19. Example of LHV Stored in a Dataset

CARDS ARE TO BE READ FROM BOTTOM TO TOP



```
--------END OF SECOND LIST------------------          END LIST
LIST OF SOME OF THE DATASETS PREVIOUSLY DEFINED.      INSERT
LIST OF SOME OF THE DATASETS PREVIOUSLY DEFINED.      INSERT
ANOTHER LIST DEFINED FOR PURPOSES OF THIS EXAMPLE     BEG LIST
```

Figure 3.20. Use of the INSERT Card for List Definition

TABLE 3.3

SUMMARY OF STRUCTURE CARDS

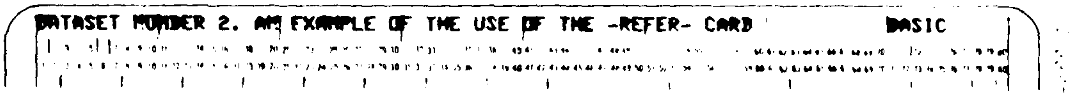
Card Type	Entity Named on Card	Entity Inside Which Data on Card is Placed	Result
REFER	Dataset	Dataset	One data word, the DSP word address
REFER	Dataset	List	Places dataset on list
REFER	List	Dataset	One data word, the LHV
INSERT	Dataset	Dataset	Copies data from named set into new set
INSERT	List	List	Copies list from named list into new list
	(Anything Else)		Diagnostic--fatal error

itself). FLEXRED will identify this (and more complicated variants) as an error and return a diagnostic. The REFER card is subject to no such logical difficulties and may be used anywhere.

The Basic Dataset. We have discussed the construction of individual datasets and lists. It is necessary to communicate or interface this entire data structure built by data cards with the user's program. This is done via the basic dataset, through which it must be possible to reach all data entered by FLEXRED. The basic dataset is locked into position by FLEXRED and its dataset index returned through its calling sequence.

Any one dataset may be defined as the basic dataset, through the use of the BASIC card, as shown in Fig. 3.21. The basic datas t provides the means to reach all other entities read during the FLEXRED run, and any entities not accessible directly or indirectly through the basic dataset are destroyed.

The basic dataset can provide access to entities in several ways. Values can be entered directly in the basic dataset, or DSP words or LHV words may be entered in the basic dataset which point to other datasets or lists. A chain of reference may be built up in which datasets and lists which are immediately referred to in the basic set point in turn to



```
DATASET NUMBER 2. AN EXAMPLE OF THE USE OF THE -REFER- CARD                BASIC
```

Figure 3.21. Example of the BASIC Card

other datasets and lists. Thus, any variable entered through FLEXRED has to be linked either directly or through a chain of DSP and LHV words to some variable in the basic dataset.

3.2.1.3 Formatting and Comments

A card whose first character is an asterisk is a comment card of some sort in the data deck. If columns 71-80 are blank or contain something other than PRINT, BOX, or BOX PAGE, the card will be skipped and ignored by FLEXRED. This allows the user to intersperse his data deck with comments of a technical nature (which may assist in modifying the data deck) without having them appear to clutter up the output.

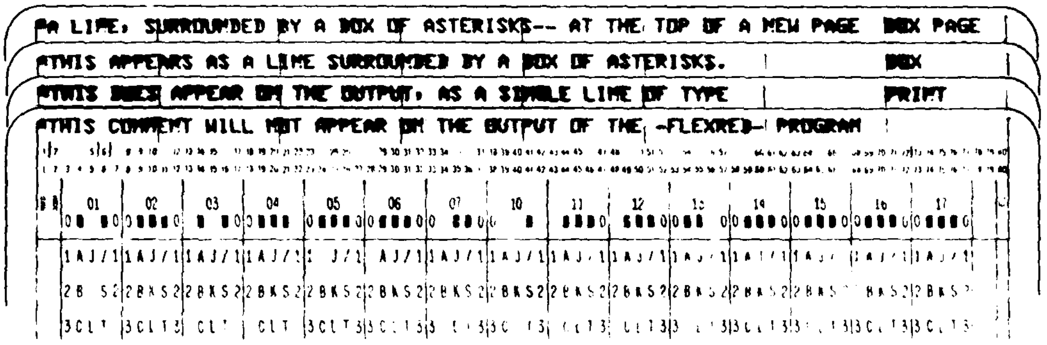
If the word PRINT occurs starting in column 71, then the contents of columns 1-70 appear on the output as a single line. If the word BOX occurs starting in 71, then the contents of columns 1-70 appear inside a box composed of asterisks. (Consecutive BOX cards produce only one box, containing multiple lines of output.) Finally BOX PAGE produces a box, and a skip to the top of a new page. Figure 3.22 shows some samples of these cards.

3.2.2 OUTLIS

The purpose of this routine is to perform general-purpose output for lists of data which have been previously generated internally by the ROSCOE simulation. These data take the form of lists of datasets (the so-called output datasets) which are constructed from time to time within the program while it is running. Each dataset on such an output list (of which there may be more than one) is presumed to be of the same form. That is to say, each dataset must be of the same length, and contain values of the same variables. In addition, the contents of each such dataset are presumed to be known to the user, who must decide how he wants the output to be formatted, scaled, and graphed or printed.

Four different types of output are currently provided for in subroutine OUTLIS: (1) a state-vector form of output based on the STOUT

CARDS ARE TO BE READ FROM BOTTOM TO TOP



```
*A LINE, SURROUNDED BY A BOX OF ASTERISKS-- AT THE TOP OF A NEW PAGE  BOX PAGE
*THIS APPEARS AS A LINE SURROUNDED BY A BOX OF ASTERISKS.             BOX
*THIS DOES APPEAR ON THE OUTPUT, AS A SINGLE LINE OF TYPE             PRINT
*THIS COMMENT WILL NOT APPEAR ON THE OUTPUT OF THE -FLEXRED- PROGRAM
```

Figure 3.22. Sample Formatting Cards

subroutine of the TRAID system, which includes provision for some coordinate conversions; (2) a columnar form of output which is based on the OUTCOL subroutine of the TRAID system, but which has additional capabilities such as automatic scaling of the output variables; (3) a graphical form of output using the printer as a rudimentary plotter, based on the SETPLOT routine of the TRAID system; and (4) a Calcomp plotter output capability with automatic axis scaling, based on Calcomp-supplied software. The user may select any combination of these at run time by means of data inputs which define "format" datasets which are interpreted in combination with the lists of output data to provide flexible output in a readable form. These four types of output will now be discussed in greater detail.

3.2.2.1 State Variable Output Formatting

In this form of output, it is assumed that the data on the output list is a series of ten-word datasets corresponding to the standard TRAID state vector, composed of time, followed by the nine components of position, velocity, and acceleration. These will be output according to the capabilities of subroutine STOUT of the TRAID system.

The structure of the format dataset which implements the state variable output capability is:

Word	Contents
1	STOUT (a single Hollerith constant)
2	An integer code word, described below
3-10	The (Hollerith) title to be used at the head of the output array

The OUTLIS program detects the Hollerith constant, STOUT, and proceeds with the state vector form of output.

The integer code word consists of six independent digits (in base-10 notation) which are decoded by the same program and serve to control the type of output which is desired. These digits are, reading from left to right in the code word: KF, KN, KI, KP, KV, and KA. Their use is as shown in Table 3.4.

This output routine does, however, assume that the state vectors provided to it in the datasets on the data output list are in an appropriate coordinate system to begin with. As indicated in the table, for KP = 1 the form is assumed to be in rectangular coordinates, whereas for KP = 2, 3, or 4 , the form is assumed to be space polar.

3.2.2.2 Columnar Data Output

In this form of output, it is assumed that the data on the output list is a series of datasets (of no prescribed length) with identical structure. Each dataset will represent a single "line" of output in a tabular format. The user may select which column on the output sheet that particular data word will be printed in, how it should be scaled, and what the column heading should be.

TABLE 3.4

COMPONENTS OF THE CODE WORD IN STATE VARIABLE FORM OF DATA OUTPUT

KF	Format control for number printout
KF = 0	F10.3 conversion
KF = 1	E11.2 conversion

KN	Name output control
KN = 0	Names not printed
KN = 1	Names printed for each line

KI	Identification control (*leftmost printed column*)
KI = 0	None
KI = 1	State vector entry 1 as time
KI = 2	State vector entry 1 as Hollerith ID
KI = 3	State vector index number in array of states

KP	Position printout control
KP = 1	Rectangular coordinates (x, y, z)
KP = 2	Polar coordinates (r, θ, ϕ)
KP = 3	Radar coordinates (range, azimuth, elevation)
KP = 4	Geocentric coordinates (altitude, longitude, latitude)

Above values plus 5: positions labeled as "Reference Position"

All vectors in array must be in rectangular coordinates for output with KP = 1, and in polar coordinates for output with KP = 2, 3, or 4.

If the integer code word is negative, position output is deleted and the index KP defines the coordinate system used for the velocity and acceleration printouts below.

KV	Velocity printout control
KV = 0	Velocity printout deleted
KV = 1	Rates of position coordinates ($\dot{x}$, $\dot{y}$, $\dot{z}$ or $\dot{r}$, $\dot{\theta}$, $\dot{\phi}$, etc. depending on the choice of KP)
KV = 2	Rectangular velocity components ($\dot{x}$, $\dot{y}$, $\dot{z}$ or $\dot{r}$, $r\dot{\theta} \cos \phi$, $r\dot{\phi}$, etc.)
KV = 3	Polar velocity components (velocity magnitude, azimuth, elevation)
KV = 5	Polar coordinates of radar boresight, stored in velocity components of state

Above values plus 5: components 5 to 7 of state are scaled and labeled as position deviations

KA	Acceleration printout control
KA = 0	Acceleration printout deleted
KA = 1	Second derivatives of position coordinates ($\ddot{x}$, $\ddot{y}$, $\ddot{z}$, etc.)
KA = 2	Rectangular acceleration components
KA = 3	Polar acceleration vector (magnitude, azimuth, elevation)
KA = 4	Acceleration relative to velocity (magnitude, component parallel to velocity, component perpendicular to velocity)

Above values plus 5: components 8 to 10 of state are scaled and labeled as velocity deviations

The structure of the format dataset which implements the columnar output format is:

Word	Contents
1	OUTCOL (a single Hollerith constant)
2-9	The Hollerith title to be used at the head of the output array
10	An integer code word, described below
11	10-character top line of column heading
12	10-character middle line of column heading
13	10-character bottom line of column heading
14	Numerical scale factor to be applied to each data item in the column
15-19	Same data as 10-14 for another column
20-24	Same data as 10-14 for another column; and so on for as many columns as output is desired for

The code word (thought of as a decimal integer) is a positional composite of four other words; it is of the form NNPCF, composed of the integers, reading from left to right, NN, P, C, and F. These have the following meanings to the output routine:

NN = the index, within the output dataset, of the data item for which this is an output instruction.

P = the "page" on which this column of output is to be placed; P = 0 is the "first" page, P = 1 the second, and so on to P = 9 . The word "page" means output array, rather than physical page of printout.

C = the column on that page in which the output is to appear. There are ten 12-character columns on a page of computer printout; they are numbered 1, 2, 3, 4, 5, 6, 7, 8, 9, and 0, reading from left to right.

F = the output format (in the FORTRAN sense) under which the words in this column are to be printed. The possible codes range from 1 through 9 inclusive; their meanings are shown in Table 3.5.

TABLE 3.5

CORRESPONDENCE BETWEEN DIGITAL CODES AND FORTRAN FORMATS IN COLUMNAR FORM OF OUTPUT

Code Digit	Format
1	E12.4
2	E11.2
3	F11.6
4	F11.3
5	F10.0
6	I8
7	I10
8	Ø12
9	A10

It may be noted that there is no requirement that a column be printed only once; typically in time-series data the time column is printed once on each "page" of output. If one inadvertently specifies two different outputs for the same page/column pair, the latest one in the *format* dataset will govern.

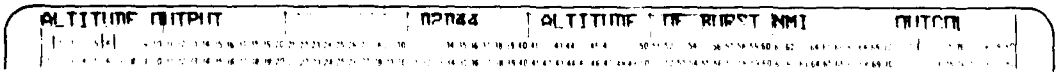
Mention should be made here of a special input card which is recognized by FLEXRED and will allow the easy specification of the five-word segment of the format dataset corresponding to a particular output column. This is the OUTCOL card. Because of its specialized nature, its discussion was deferred until here. It is identified by FLEXRED by means of the word OUTCOL punched starting in column 71. The code word is punched in field 31-40; the top, middle, and bottom lines of the column heading are punched in fields 41-50, 51-60, and 61-70, respectively. If the word punched in 61-70 as the bottom line of the column heading is left-justified and recognizable by FLEXRED as being a scaling factor with which it is familiar, it will automatically define the correct scale factor and store it in the format dataset for OUTLIS to use later. If the word is unrecognizable, on the other hand, FLEXRED will assume that this column is to be unscaled, and will put in a 1.0 for a scale factor.

Figure 3.23 shows a sample OUTCOL card. It will be noted that this is an instruction to OUTLIS to take the second word in each successive output dataset (NN = 02) and print it in the fourth column (C = 4) of the first output array (P = 0), after scaling it into nautical miles (i.e., after dividing by 1853.25), using a FORTRAN F11.3 format (F = 4). The resulting output will look like the following:

```
   ALTITUDE
   OF BURST
  NMI
      50.357
     126.780
     etc.
```

3.2.2.3 Printer Graphic Form of Output

In this form of output, it is assumed that the data on the output list is a series of datasets (of no prescribed length) with identical structure. The user may select in turn pairs of data words which are to be plotted against each other, using the line printer as a gross plotting



```
ALTITUDE OUTPUT          02044    ALTITUDE OF BURST NMI        OUTCOL
```

AN-44974

Figure 3.23. A Sample OUTCOL Card

mechanism. This form of output does not allow for any scaling of the data, and the axis scaling is quite crude. It is designed primarily to obtain a rapid overview of the joint variation of two variables, rather than a polished output.

The structure of the format dataset which implements the graphical output format is:

Word	Contents
1	GRAPH (a single Hollerith constant)
2-9	The Hollerith title to be used at the head of the graph
10	Index (integer) in the output dataset of the data word to be graphed along the x-axis
11	Index (integer) in the output dataset of the data word to be graphed along the y-axis
12-21	Another title and pair of indices as in 2-11 for another graph from the same serial list of datasets
22-31	Another such definition; and so on

No axis labels are provided for, and axis scaling is automatically chosen to include all the data points within the plot field. This output method is extremely rapid, but suffers from low resolution.

3.2.2.4 Calcomp Plotter Form of Output

In this form of output it is assumed that the data on the output list is a series of datasets (of no prescribed length) with identical structure. The user may select in turn pairs of data words which are to be plotted against each other by a Calcomp plotter (or some other plotting device for which the appropriate software has been written).

This graphical output allows the user to specify a title for the graph, individual labels for the x-axis and y-axis, and scaling for the variables to be plotted along each axis. The program will then select appropriate scaling parameters so that the tick marks on the axes are at convenient values, and so that the plotted graph "fills the field." The structure of the format dataset which implements the Calcomp output format is:

Word	Contents
1	CALCOMP (a single Hollerith constant)
2-9	The Hollerith title to be used at the head of the graph
10	Index (integer) in the output dataset of the data word to be plotted along the x-axis
11-12	Two-word Hollerith label for the x-axis
13	One-word Hollerith scaling factor name describing the units to be used along the x-axis
14	The value of the scaling factor associated with the units defined in 13
15	(intentionally blank)
16-21	Equivalent to words 10-15, but now defining the y-axis and its structure
22-41	Same as 2-21, but for a second graph to be constructed from the same sequential list of data arrays
42-61	Same as above; and so on

It should be noted here that words 10 through 14 (and all later sequences) are designed so that they may be read in by FLEXRED on a single OUTCOL input card, allowing FLEXRED to provide the value of the scaling factor automatically if its Hollerith name is one which it has learned to recognize. The use of these cards, and their format, are the same as in Sec. 3.2.2.2, where they were used to input and scale columnar data.

The routines in this Calcomp package are all Fortran except for two system subroutines, PLOTS and PLOT. Since these routines will have to be replaced when moving ROSCOE to another facility, they will be briefly described as to function. The presumption is that the associated plotter has a 10 × 13-inch plotting field.

PLOTS. Within a program which is to use the plotter, this routine must be the first to be called. It initializes various parameters and the position of the pen at the edge of the graph paper. The pen will be up. This point is defined as the origin (0.,0.) until it is redefined by a termination call to PLOT.

PLOT (X, Y, IC). This routine's calling sequence gives the following instructions.

X = abscissa in inches

Y = ordinate in inches

IC = control of pen

3--lift the pen

2--lower the pen

1--leave the pen as it is

If IC is negative, the pen will be positioned as above and the current plot will terminate at coordinate X,Y. This position on the paper is then defined as (0.,0.) for the next plot.

Thus PLOT moves the pen from the current position to (X,Y) with the pen up or down depending upon IC.

3.2.3 ROSCOE Inputs

From the preceding discussions, one can begin to perceive the flexibility built into the input/output structure of ROSCOE. Once the dataset structure is understood,[1] very simple or extremely complex data packages can be pieced together, depending on how the program is to be used.

[1] Volume 3 presents a complete programmer's notebook of all ROSCOE datasets and definitions of all variables in those datasets.

In this section, we will go through an example data deck in some detail to illustrate the use of the FLEXRED/OUTLIS structure. We start with a review of the dataset "tree" structure concept as it relates to ROSCOE specifically.

3.2.3.1 The "Tree" Structure Concept

As discussed in the description of FLEXRED above, the dataset structure ("tree" structure) starts with a dataset termed the BASIC dataset. All other datasets either created in the input deck or created later within the code are tied to this basic dataset either directly or indirectly through other datasets and lists. Thus to create a ROSCOE data deck, one starts with the ROSCOE basic dataset and begins constructing the tree structure required for his particular job.

An example of such a tree structure is shown in Fig. 3.24. The ROSCOE basic dataset contains these items:

Event List

Function -- a list of the events that will be processed in a time ordered fashion within the program.

Options -- The user should always specify an attack generation event (since it initializes the ambient atmosphere and magnetic field) and a stop event to terminate execution. He then has the option of setting up an attack, that is, inputing an attack type dataset, a launch point list and target point list. Other optional events would be burst events (as many as he desires) each pointing to a bomb type dataset; an environment output event to produce specific phenomonelogy data at points in nuclear disturbed regions; a satellite communications event (see Vol. 20); or an optional surveillance event (see Vol. 21-1). Note that the attack generation event creates radar look events for each object/sensor pair at the radar acquisition range(s) internally.

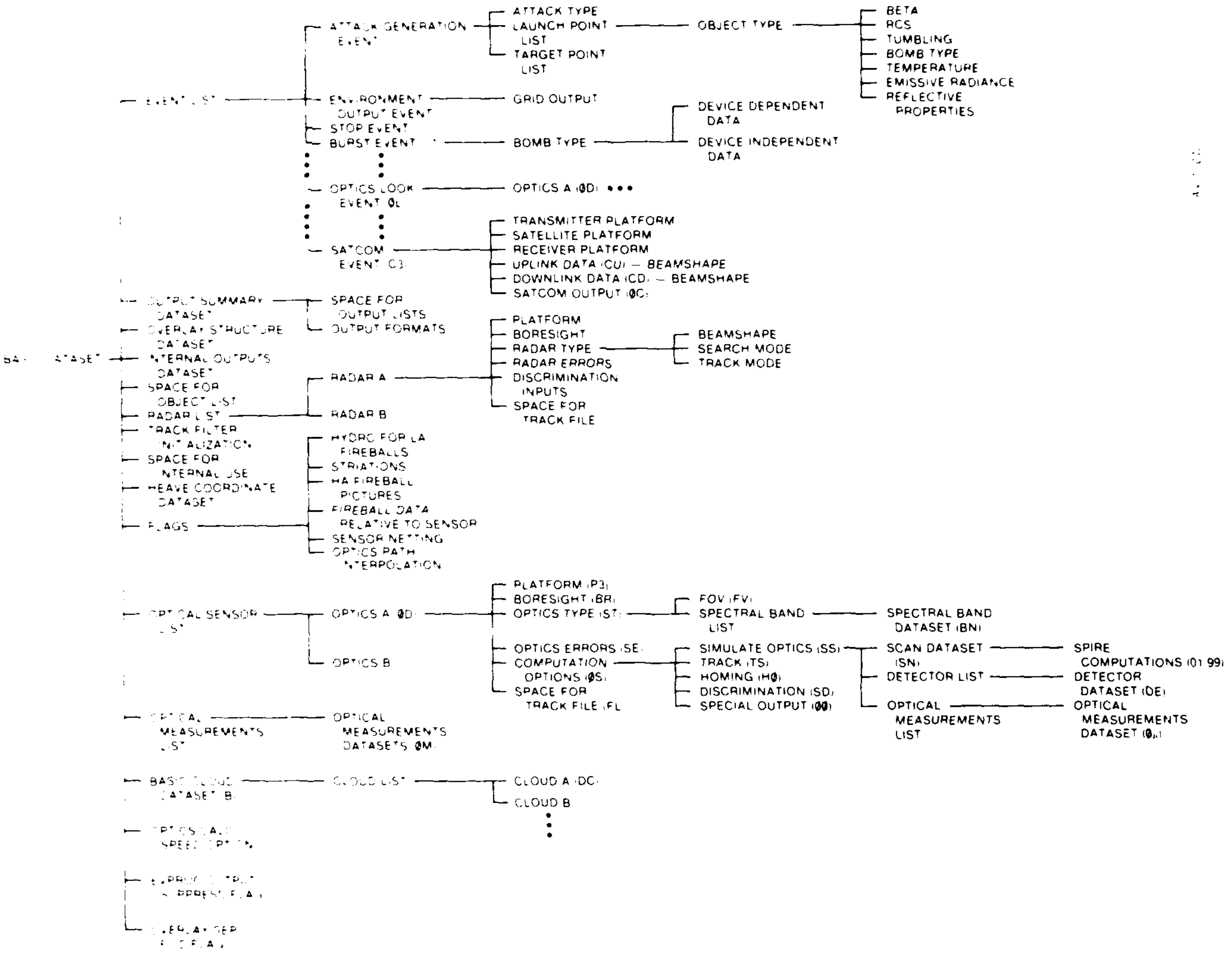


Figure 3.24. ROSCOE Dataset Organization

Output Summary Dataset

Function -- to provide lists and format datasets for preparation of summary output within the program.

Options -- The user satisfied with the form of the outputs provided can leave this dataset string as it is. The user who would like the data in a different format (or printer plot output of any two items) can merely add additional format datasets to the format lists provided. The user who would like additional output can add new format lists and insert a new code to generate these data internally.

Overlay Structure Dataset

Function -- ROSCOE is intended to be a programming system rather than a code. This dataset allows for the addition of replacement overlays at input time.

Options -- If the programmer/user would like to use a program module of his own to replace one in the code, he can add the routines to the program library structure and specify that the appropriate event number call his overlay. This will require changing the appropriate overlay in the program structure (STRUCT) file. (Note that a comparable option exists at the subroutine level. The user can replace an existing subroutine with his own by giving it a different deck name with an entry name corresponding to the ROSCOE deck. He should then replace the original INSERT, old deck with his INSERT, new deck in the STRUCT file).

Internal Outputs Dataset

Function -- Provides for internal debug outputs. Write statements have been inserted in each event of the code to provide important data as they are computed.

Options -- By inputting the Hollerith flag "NO" the debug output is suppressed for that event. A "YES" flag turns on the output for that event. The casual user should probably ignore the debug print.

Space for Object List

Function -- To leave space for the object list created in the attack generation event.

Options -- Alternatively, one could input an object list rather than generate it within the attack generation event. In this case he would need the object states at an appropriate engagement time from some other program and would have to input the dataset string associated with each object (i.e., object type, beta, RCS, tumbling and bomb type datasets), and also a radar look event for each object on the event list.

Radar List

Function -- Lists all radar sensors to be used in this engagement.

Options -- There are no limitations on the number of radars that can be input (although large numbers will overload the dynamic storage system and considerable CP time will be spent allocating storage). For each radar, the dataset string shown must be entered.

Track Filter Initialization

Function -- A dataset to provide initialization paramaters for the Kalman filter used.

Options -- None, unless the user would like to use his own filter.

Space for Lists

Function -- There are a number of spaces allocated here for internal storage of lists (bursts, fireballs at different times and altitude regimes, etc.).

Options -- None. These should not be changed.

Heave Coordinate Dataset

Function -- Provides a description of the grid region desired for high altitude nuclear engagements.

Options -- If a zero card is entered, a grid region will not be generated. This will be the case where the user is only interested in low-altitude (<90 km) detonations. If a REFER card is entered here, then a heave coordinate dataset should be entered somewhere in the input stream.

Flags

Function -- A number of flags are supplied to allow the user the option of simulating specific phenomenology, or providing additional output.

Options -- A "NO" flag means the item will not be computed; a "YES" entry means that it will be computed. The flags are:

(1) Hydro around low-altitude fireballs--factors in the motion of air particles around low-altitude fireballs for chemistry calculations. This calculation can be time consuming for large numbers of multi-burst calculations. Its importance is a function of the geometry of the ray path intersections with the disturbed regions. Probably should be used for a limited set of ray paths rather than in a complete tracking simulation.

(2) Striation calculations--this flag allows for the calculation of striations in the high-altitude grid region. It is important for high yield detonations, and for times longer than a few tens of seconds after burst.

(3) Printer plots of HA fireballs--this option allows the user to get printer plot pictures of all high-

altitude fireballs and the beta tubes eminating from them. These plots require little computation time so the default has been set to "YES" in the standard decks provided.

(4) FB data relative to radar--this option provides the position and extent of all low-altitude fireballs relative to each radar specified. It also provides the clutter contribution to the radar from each fireball.

(5) Sensor Netting--an option which allows all sensor data to be netted. The alternative is that each sensor operates autonommously.

(6) Optics Path Interpolation--allows for time interpolation of optics propagation data. The path integrations can be time consuming so for large FOV applications which require many paths or for large attack engagements this option should be used.

Optical Sensor List

Function -- Lists all optical sensors to be used in this engagement.

Options -- There are no inherent limitations on the number of optical sensors or sensor types that can be specified.

Optical Measurements List

Function -- Contains a list of optical measurement datasets which contain measured position coordinates of a target relative to the sensor boresight, the magnitude of the signal, etc.

Options -- These are created internally so a zero card should be used in the input deck to leave space for it.

Basic Cloud Dataset

Function -- Allows for the treatment of natural clouds in the optics calculation.

Options -- The user either inputs a "zero" card (no clouds) or card which refers to a basic cloud dataset which appears later in the input stream.

Optics Calculation Speed Option

Function -- To allow the user an option on computation speed.

Options -- The user inputs either "fast" or "slow". The default value is "slow". The "fast" option allows for run times to be reduced by about one-half, but does not produce the fidelity which the "slow" option affords.

EVPROC Output Suppression Play

Function -- Allows the user to suppress a standard printout which shows the ordering of events as they are processed and the computation time expended.

Options -- User inputs either "1.0" or "0". The default is 1.0, which enables the printout.

Overlay Separate File Flag

Function -- A flag to direct the code to use separate files for each overlay, which allows considerable savings in "ID" time changes.

Options -- "ID" or "0" should be input. Default is "1D" which directs the code to use the separate files.

3.2.3.2 Sample Data Deck

For our own studies at GRC, we have found it convenient to set up a large complex data package from which many variations can be run. The data deck includes five high-altitude bursts , a UHF radar model, a communications satellite and ground receivers, and a SWIR surveillance sensor on a synchronous satellite.

The deck is saved as a CDC UPDATE[1] file so that the deck can be edited and updated to run different problems. A listing of this UPDATE file is given in Appendix A. A description of the cards contained in the file follows.

1. <u>Title and Initialization</u>. (Data .2 - Data .5)

   Data .2 and Data .3 are used for titling the output. Data .4 sets the earth rotation to on or off with input of YES or NO, respectively. Data .5 provides a starting point for the random number generator (used in structuring random RV attacks). Note that these first four cards, which are required, do not follow the FLEXRED format --FLEXRED formats are used for all other inputs.

2. <u>Scale Factors</u>. (Data .6 - Data .32)

   As mentioned in the FLEXRED description, the user can specify scale factors so that inputs can be scaled properly to internal units (CGS for ROSCOE). Note the unusual set required to convert to range in centimeters on a one-square-centimeter target (Data .27 - Data .29). The scale factor (K) required to convert km on one-square-meter to cm on one-square-cm is derived as follows:

$$S/N \propto \left(\frac{R_{MKS}}{R}\right)^4 \sigma$$

where R_{MKS} = range in km on a one-square-meter target

so that R_{MKS} has the units km/m$^{1/2}$. Thus

$$K = \left(\frac{km}{m^{1/2}}\right) \frac{(10^5\ cm/km)}{(10^2\ cm/m)^{1/2}}$$

$$= 10^4$$

[1] UPDATE is a CDC software package for maintaining source libraries by use of flexible editing features.

3. Basic Dataset. (Data .33 - Data .63)

As mentioned earlier, the basic dataset is the primary element in the data structure from which all other datasets and lists emanate. The ROSCOE basic dataset has a fixed structure containing those variables described above in Sec. 3.2.3.1.

The datasets and lists referred to in the basic dataset by REFER cards follow in the input stream.

4. Instructions for Internal Outputs. (Data .64 - Data .97)

This dataset establishes the debug output flags for each event. Note that the first card (card 65) must have the exact wording specified on the REFER card in the basic dataset and must have BEG SET starting in column 71.

5. Overlay Structure Type Dataset. (Data .98 - Data .131)

This dataset sets up the overlay calling structure by event. The purpose of this dataset is to allow for alternate overlays to be constructed and substituted for the existing ones.

6. Miscellaneous Datasets for Summary Output. (Data .132 - Data .440)

Output Summary Dataset. (Data .132 - Data .164)

This dataset provides space for the output lists that will be filled during program execution (the system output list, and the physics output lists designated as BO, F1, F2, F3, F4, D1, BE, CO, OC, OS and OP--see Volume 3 for definitions), and sets up pointers to the format lists which follow in the input stream.

Format Lists. (Data .165 - Data .200)

The format lists for each of the output types (trajectory output, track measurement errors, etc.) can contain any number of output format datasets for tabular output, printer plots, or Calcomp plots. Each separate output type must be defined by a dataset, however.

In the current example, a single tabular output format dataset is used for each systems and physics output.

Individual Output Instructions. (Data .201 - Data .440)

The individual output format datasets are given in this block of inputs. The format datasets all have the "columnar" form described in Sec. 3.2.2.2. The first card is a dataset descriptor which must correspond to a card image on one of the output format lists. The next card defines the type of output to be used--defined by the work OUTCOL in column 41. The third card is a title card for the tabular output. The title is punched in columns 1-71, and the work TITLE must be punched starting in column 71.

The next set of cards (up to ten) define the output data by column. The cards are punched as follows:

Columns 1-30:	A description of the variable.
Columns 31-40:	The code word as described in Sec. 3.2.2.2.
Columns 41-70:	Descriptors which are printed at the top of each column. The first field of ten is printed on the first line, the second on the second line, and the third on the third line. The data may be scaled to any convenient units by using the third field for the unit name of a previously defined scale factor. In this case, the scale factor must be left-justified to distinguish it from a label.
Columns 71-80:	The word OUTCOL.

7. Event List. (Data .441 - Data .459)

The event list must contain an attack generation event to initialize the atmospheric, ionospheric, and magnetic field models, and a stop event to terminate program execution; however, no other events are mandatory. The user can specify any number of burst events or an environment output event if desired. All events specified must have a dataset somewhere in the input stream, however.

8. Attack Generation and Battlespace Initialization.

(Data .460 - Data .512)

This block of data contains those datasets associated with the attack generation event and general problem initialization.

Attack Generation Event. (Data .461 - Data .466

The attack generation event consists of the event type variable (1 in this case), a dummy event time, and pointers to the attack type dataset, the launch point list, and the target point list.

Attack Type Dataset. (Data .468 - Data .482)

Only a uniform attack (RVs spaced uniformly in time) can be specified at present; however, other attack types could be added easily. Other inputs include: a day or night specification (which is currently overridden in the initialization portion of the atmospheric model), the attack date (day, month, year) and time of day (zone time at the burst location), an approximate battlespace center location for the magnetic dipole fit, an initialization flag used internally which should be set to zero, and four parameters to describe the terrain for optics calculations (see Volume 7).

Launch Point List and Datasets. (Data .483 - Data .495)

Any number of launch points can be put on the launch point list. Recall that each launch point has an object type associated with it, so that object types are mixed by mixing launch points.

In the example, only one launch point (THE LAUCHOU LAUNCHERY) is listed. The launch point dataset contains the launch point name (LAUCHOU), the location of the launch point, pointers to the booster and object types, the number of boosters available at this launch point (or of this type), and space for an internally used variable.

Target Point List and Datasets. (Data .496 - Data .512)

The target point list also can have any number of targets listed. Arrival sequence is determined by the order of the target list and the corresponding order of the launch point list. For the first target point, the program selects the first launch point (and object type) and constructs a trajectory between the points. For subsequent objects on this target or other target points, any remaining boosters at the first launch point are used until these are exhausted; then the second and succeeding launch points are used.

Only one target point is specified in the example--BUFFALO, NEW YORK. The target point dataset includes a target name, BUFFALO, the target location, the number of boosters on target, the arrival time (at the target) of the first RV, the delta time between arrivals of successive RVs, the standard deviation in arrival time (if any), the CEP about the impact location, a mode indicator for the trajectory type desired, a trajectory descriptor, and space for a target output array. The following options are available for describing the trajectory:

Mode	Trajectory Descriptor Input
1	Flight time
2	Excess flight time (above minimum-energy orbit)
3	Speed at launch (inertial)
4	Velocity-elevation angle at launch (inertial)
5	Speed at launch (relative to ground)
6	Velocity-elevation angle at launch (relative to ground)

System Output List. (Data .513 - Data .518)

This list contains output datasets for each radar/object pair. The list is created internally when the RV trajectory generation option is used to drive the radar look event logic (i.e., radar look events are created as RVs enter the radar fields of view and output datasets are created to hold the measurement data). However, if the user bypasses the RV trajectory generation by inputting object states directly and putting a radar look event on the event list then he must also set up a system output dataset for each radar/object pair.

High Altitude Heave Grid. (Data .519 - Data .540)

A grided region is used to model the high altitude (>90 km) disturbed regions. A reference location for the center of the region is input first (Data .520 - Data .521). This is followed by the heave coordinate dataset which contains the specifications for the size and orientation of the grid.

Data entries for the bottom altitude, the heave coordinate center (may be relative to the reference position given above), the angular cell widths,[1] the number of vertical cells, the number of columns in the positive and negative x- and y- directions,[2] and the azimuth of the x-axis (measured positive in the clockwise direction from north) must be specified. (The specification MAGNETIC aligns the negative x-axis with magnetic North.) In addition, the number of cells (NMCEL ≤ 100) used in the magnetic grid for striation calculations is specified if striations are computed. This input variable is followed by initialization inputs for the two times at which grid data is saved, a space for an internal flag (IXPLD), flags for turning on energy check calculations (INCHK) and rezoning the grid cells in a column (IRZN), space for the cell heights (used internally), and the altitude (HMAX) at which a column should be rezoned. The energy check and rezoning calculations are actuated by setting the flags equal to 1.; otherwise, zeros should be entered as shown.

Placement and size of the heave grid relative to bursts is important. For some situations, experimentation may be required. In general, grid cell dimensions should be set so that at least four or five cells are contained within the initial fireball region. Differences will also appear due to placement of bursts within grid

[1] Cell widths in the x- and y- directions are measured in geocentric angular units.

[2] The code allows a maximum of 1300 cells. There can be as many as 18 vertical cells and 20 columns along the x-axis and 20 columns along the y-axis. For example, a grid of 10 x 10 x 13 in the x-y-z directions can be accommodated.

cells (at cell edges compared to cell centers); this is a natural consequence of the granularity of the grid calculations.

Note that the number and size of the cells should be made large enough to cover the battlespace of interest. For points outside (i.e., below the bottom, above the top cell center, and outside the bounding tubes), ambient properties are assumed.

9. Object Data. (Data .541 - Data .623)

Object data can be input in two ways. The user can imput either object coordinates directly (suitable for endo-atmospheric problems) or the object trajectory by using the launch point and target point lists described above. In the second case, the user can ignore these and skip to the booster type and object type datasets below.

Object Datasets. (Data .542 - Data .579)

In the example data deck, spaces have been allocated for two objects. To use these, the user should change these "zeros" cards to "refer" cards. The object datasets (Data .545 - Data .552 and Data .564 - Data .569) contain the following data:

Card 1 Beg Set card (name must correspond to name referred to on object list)

Card 2 Object name (user selected)

Card 3 Pointer to object type dataset

Card 4 Pointer to object position dataset

Card 5 An internal flag

Card 6 Pointer to radar cross section dataset

Card 7 Pointer to object tumbling model dataset

Card 8 Space for track file associated with this object

The object position datasets(Data .553 - Data .563 and Data .572 - Data .579) contain ten spaces for orbital element storage internally, the reentry time for the object (not used in this mode), the state of the object (time, position, velocity, acceleration) which the user specifies, a pointer to the ballistic coefficient dataset and space for a beta multiplier for modification of the beta table (not used in this mode and internally set otherwise).

Booster type data is entered when booster plume tracking with an optical sensor is to be performed or when a full object trajectory from launch point to impact point is desired. The booster dataset contains a user selected name ("PLUME" in the example), a reference to the launch point associated with this booster, and a booster stage list.

A two stage booster is given in the sample deck. Inputs for each stage include fuel type (either "SOLID" or "LIQUID"), thrust, initial weight, final weight, nozzle area, burn time, the integration step size for trajectory calculations, the aerodynamic reference area, and a table of axial coefficients versus Mach number.

Object Type Data. (Data .613 - Data .619)

The object type is described by an object name (OVERSHOE in this example), a pointer to a ballistic coefficient dataset, the reentry altitude where drag should start, a pointer to the radar cross section for this object, a pointer to the bomb type, and a pointer to the tumbling model.

Ballistic Coefficient Dataset. (Data .621 - Data .623)

The ballistic coefficient (beta) can be modeled with a constant (model type = 1), with a beta/altitude table (model type = 2), or using a cone-aerodynamic model (model type = 3). The datasets corresponding to these models are B4, BT, and B3, respectively (see Vol. 3).

The object ballistic coefficient in this case is modeled as a constant. The dataset for this model contains the model type (1.0), and the ballistic coefficient.

10. Radar Event and Radar Datasets. (Data .624 - Data .759)

There are a large number of radar inputs, beginning with the radar look event and radar list. The user can elect to set up his own initial radar event by putting the event on the event list and entering the object data as described above, or he can merely input a radar list and use the trajectory generation option (must input launch points and target points as described above) in which case the program sets up radar looks for each object as it enters each radar field-of-view. Note that in the sample data deck provision is allowed for either option; that is, a radar event is entered on the event list (although with a large event time) and launch point/targets point lists are entered (except that the number of objects is set to zero). Thus the sample deck can be used in either case by either inputting the desired radar lock event time or inputting one or mare objects on the launch and target point datasets.

Radar Event Dataset. (Data .625 - Data .634)

The radar event dataset consists of the event type (4.0, which should not be changed), the event time (user specifies), pointers to the radar and object used in this event, and eleven additional parameters that are either internally generated or should not be changed.

Radar List and Radar Datasets. (Data .635 - Data .645)

In the current example, a single radar is specified, called RADAR B. The RADAR B dataset contains a name (RAD/B), pointers to platform, boresight, radar type, radar errors, and discrimination input datasets, and space for a track file list used internally.

Boresight Dataset. (Data .649 - Data .652)

The boresight dataset contains Hollerith flags indicating whether a face can acquire the target followed by the boresight vector. In the example, only one radar face is specified which can acquire. Note that the boresight vector is specified in polar coordinates relative to the geographic coordinates (GEOR card 647) just above it.

Radar Errors. (Data .654 - Data .661)

Fixed and signal-to-noise-dependent errors in range, azimuth, and elevation for the two faces are input in the form shown. Bias errors for the three measurements can also be input if known. Zeros have been entered for bias errors in the example.

Discrimination Input Dataset. (Data .663 - Data .673)

Discrimination inputs consist of the discrimination type (either WBL, wide-bandwidth length, or FFL, fine-frequency length), the body length, the time interval for discrimination pulses, the altitude below which fine-frequency length measurements cannot be made, the total time during which discrimination pulses will be sent, a range limit beyond which wide-bandwidth length measurements cannot be made, and the noise bandwidth.

Radar Type Data. (Data .675 - Data .687)

Radar type data consists of a radar name, a Hollerith flag for beam stacking, pointers to datasets (radar errors, transmit beamshape, receive beamshape, search mode parameters, and track mode parameters), the radar frequency, the effective noise temperature,[1] the radar horizon limit, the off-boresight angle limit, and a Hollerith flag indicating antenna polarization.

Search Mode Parameters. (Data .690 - Data .708)

Separate radar parameters are given for the search/verification and the track-initiation/track functions. The search/verification parameters define the search sector plus the other characteristics shown in the example. The last card is an integer flag which allows successive search pulses to be processed. When the flag is set to 1, the track logic is bypassed.

[1] The total effective noise temperature as used here includes the sum of the system temperature and effective receiver noise temperature, which is equivalent to the noise figure times the system (room) temperature.

Radar Platform Dataset. (Data .711 - Data .713)

The radar may be placed on a number of different types of platforms (ground-based, satellite, airborne). These are designated by inputting the Hollerith names FIXED, ORBITAL, or CIRCULAR, with a set of state parameters appropriate to that model (see the P1, P2, P3 datasets in Vol. 3). For the fixed platform used in this example, only a position need be specified.

Track Filter Initialization. (Data .715 - Data .728)

The "ad hoc dataset for tracker initialization" contains a track filter beta multiplier term for initialization, the decay constants, and altitude for setting up exponential memory decay (if desired), initial values for the beta multiplier sigma and beta dot terms, and a pointer to the defense "guessed" beta table which follows in the input stream.

Transmit Beam Shape Model. (Data .730 - Data .737)

The name of the model type is specified first. Options include: CONSTANT for a mainlobe-plus-constant-sidelobe model, and TAPERED for tapered angle sidelobes. Other inputs include the beamshape (CIRCULAR or ELLIPTICAL), the beamwidth, the half beamwidth in sine space, a second input for half beamwidth in the vertical direction when an elliptical beamshape is used, the near-in angular sidelobe level, and a space for internal storage.

Track Mode Parameters Dataset. (Data .739 - Data .751)

The radar parameters used for the track initiation and track functions are shown next. Most of these parameters are well defined, with the exception of the range gate parameters. The range gate width at any time is given by

$$W = \begin{cases} W1 & \text{for track initiation} \\ W2 = K1 + K2\sigma_{RP} & \text{for track} \end{cases}$$

where K1 and K2 are inputs, and σ_{RP} is the deviation in the predicted target output by the filter.

Radar Cross Section Dataset. (Data .752 - Data .754)

The object radar cross section dataset is the next set of cards in the data stream. Here a moael specification must be made from among the four model types allowed:

Type	Model
1	Constant
2	Table interpolation of RCS with aspect
3	Tank-like objects
4	RV and decoy model

Datasets R1, R2, R3 and R4 correspond to these model types. For type 1, which is used here, the user merely inputs the RCS. For the other types, the user is referred to the datasets R2, R3, and R4 in Vol. 3.

Tumbling Model. (Data .755 - Data .756)

There are three tumbling models available: type 1--object oriented along the current velocity vector; type 2--body oriented along its initial reentry velocity vector; and type 3--a stochastic model which allows the object to tumble at a given rate to some stabilization altitude. Datasets for these three models (T1, T2 and T3, respectively) are given in Vol. 3 of this report.

The tumbling model for the object in this example is Model type 1, where the body axis is aligned with the velocity vector. With this model, no other inputs are required.

Receive Beam Shape Model. (Data .757 - Data .759)

The transmit and receive beamshape models are assumed to be identical. Thus we merely insert the transmit beamshape model here using the INSERT card.

11. Communication Event Datasets. (Data .760 - Data .842)

The satellite communications model can be run by putting a communication event dataset on the event list, and then satisfying the data input requirements that emanate from this dataset. These include: (1) the uplink dataset, which defines the parameters for the uplink transmitter-receiver pair; (2) the downlink dataset, which contains similar parameters for the downlink; (3) the transmitter platform dataset, which gives the position of the ground transmitter; (4) the satellite platform dataset, which gives the satellite starting position and orbital parameters (if desired); and (5) the receiver platform dataset, which gives the position of the ground receiver.

Communication Event Dataset. (Data .761 - Data .779)

A communication event has been input on the event list in the sample data deck. To enable the computation of this event the user should change the event time to be consistent with the burst times and other events being processed. Events will be processed at the time interval input by the user (set to 30 sec. in the sample deck). Other input options relating to the type of communication system simulated are described in Vol. 20.

Uplink and Downlink Datasets. (Data .780 - Data .830)

The user can change any of the input variables in the uplink and downlink datasets to model his particular system with the exception of the "zeros" card at the end of the datasets.

Transmitter, Receivers, and Satellite Platform Datasets. (Data .831 - Data .842)

The transmitter and receiver datasets are generally input as fixed ground platforms. The satellite platform can be input as fixed in space (as in the sample deck) or specified as following an orbit (see the P2 and P3 dataset descriptions in Vol. 3)

12. Optical Sensor Event and Optics Data. (Data .843 - Data .998)

Two types of optics problems can be simulated in ROSCOE--(1) a surveillance problem where the sensor is pointed at some reference location, or (2) a track problem where a booster plume, aircraft plume, or fireball is tracked. In the first case, the user puts an optics look event in the event list and supplies the first look time and the reference point for the look direction. In the second case, the user inputs the booster model and the burnout position.

Both types of problems are set up in the sample deck. The following sections describe how to turn them on and the calculation options allowed in each case.

Optics Look Event. (Data .844 - Data .851)

An optics look event has been inserted on the event list. To enable its computation, the user must change the event time. The look event will be set up using the optical sensor and reference position "referred" to on the next two cards of the dataset. All other inputs should be set as shown in the sample deck.

Cloud Data. (Data .852 - Data .872)

Two types of cloud modeling are allowed: (1) a deterministic model, where the user inputs the location and size of each cloud; and (2) a statistical model which allows for some average cloud statistics to be included in the optics calculation.

Clouds are modeled by putting a basic cloud dataset pointer in the basic dataset (change card 60 from ZEROS to REFER) and entering a basic cloud dataset as shown in the sample deck. The inputs for this dataset are: (1) model type (1 for statistical clouds and 0 for deterministic clouds); (2) number of deterministic clouds; (3) cloud list header (change ZEROS to REFER to enter deterministic cloud list); and (4) pointer to the statistical cloud dataset.

For statistical cloud modeling options (model number and layer number), the user is referred to Vol.24 describing this model. For deterministic clouds, the user enters a REFER card on the cloud list for each cloud he wishes to model and follows this with a cloud dataset describing the position and size of each cloud. A single cloud (CLOUDA) is included in the sample deck as an example.

The cloud index should be set to consecutively higher numbers if additional deterministic clouds are added. The cloud type parameters should be left as is since only one cloud type is currently provided for in the code.

Optical Sensor Data. (Data .873 - Data .873)

The optical sensor data begins with a sensor list. One sensor is shown in the sample deck. The optical sensor dataset includes these cards:

Card 1 -- Beg Set Card (dataset descriptor must be consistent with descriptor on sensor list).

Card 2 -- Name (user supplied).

Card 3 -- Optics type (options include TRACK and SURVEILNCE as described above).

Card 4 -- Optics calculation type (optics inclued--POINTS, which means only single line-of-sight calculations will be performed; or FOV, which means a set of lines-of-sight will be computed so that a focal plane representation of the scene can be constructed and scanned (see Vol. 33); or LOCAL, which sets up the focal plane representation as above but limits the scanning to regions about specific objects.

Card 5 -- Object types (used with LOCAL above--options are TARGETS, FIREBALLS or ALL).

Card 6-9-- Pointers to the boresight, platform, optics type and optics noise datasets.

Card 10 -- Spaces for optics options (by changing this card to a REFER the simulate optics and track simulations events can be enabled).

Card 11 -- Internal Space for a trackfile.

Card 12 -- Pointer to the optics grid dataset.

Card 13 -- Internal space for list of paths within FOV.

The optics noise, boresight and platform datasets follow in the sample deck (Data .889 - Data .903). They are self-explanatory with the exception of the acquisition flag in the boresight dataset. This parameter either allows (enter YES) or does not allow (enter NO) the optical sensor to initiate a trackfile on its own. If acquisition is not allowed, it is assumed a radar has been entered and acquisition and trackfile initiation will be performed by the radar sensor.

Optics Type Data. (Data .905 - Data .934)

Optics type data consists of an optics type dataset describing the sensor (number of detectors, blur diameter, NEFD, frame time, etc.), a wavelength band list, and a field-of-view dataset.

There are a number of options allowed for entering wavelength bands. First, the user can specify any number of wavelength bands he is interested in by putting them on the wavelength band list and entering a wavelength band dataset for each of them. In the wavelength band datasets, he can enter the end points of the band in length units (first two entries as shown in the sample deck), or he can enter the end points of the band in wave numbers (cm^{-1}). The last entry in the dataset can be set to zero, meaning no further subdivision of the band is desired; or the user can enter a list header variable to a band interval list to further subdivide the band (in which case he must enter the list and band interval datasets--see Vol. 3 for a description of these datasets); or the user can enter an integer describing the number of intervals the band should be divided into. Emission and scattering calculations are performed within the code for every band interval specified. Outputs of the radiance along a path at each band interval and the band integrated radiance are then provided.

The field-of-view of the sensor is described by setting the azimuth and elevation extent. These inputs must be limited to values not greater than 100 detector diameters. The last two inputs in this dataset are used to set baffle limits for a sensor. The first entry refers to the altitude below which the sensor cannot pick up a target. The second constraint is for upward looking sensors where an angle above the hor:zon is specified.

Optics Calculations. (Data .935 - Data .962)

Two types of optical sensor processing calculations can be simulated. The first is for the surveillance sensor application, where a field-of-view representation is computed, and a simulation of the scanning motion over the field-of-view is conducted. The second is a track simulation using the optical sensor. The processing calculations are enabled by setting up the simulate optics or track simulation event dataset pointers in the optics options dataset (i.e., making these REFER cards), and setting the event times accordingly.

Options allowed in the simulate optics event include a model type specification in which the user can select a built-in model (SURVEIL-01) or input his own (GENERAL). If the user inputs his own model, he must designate the scan pattern type (either CIRCULAR or LINEAR) and input a list header variable for the SPIRE computation list (change ZEROS card to REFER). The only other option allowed is for the plots entry. Here the user can specify whether he wants printer plot outputs of the sensor focal plane representation. The options are: OBJECTS--which produces contour plots for individual objects plus a composite plot; YES--produces only the composite plot; or NO--produces no contour plots but sets up the focal plane data for scanning and processing calculations.

For the track simulation event the user must specify the event time, the track interval, and the initial standard deviation in range used for track initialization in the case where the optical sensor is allowed to perform acquisition.

SPIRE Sensor processing Blocks. (Data .964 - Data .998)

As mentioned above, the user can input his own sensor scanning and processing model. The model is described in ROSCOE Vol. 21. An example set of processing blocks are shown in the sample deck. This set allows scanning of the focal plane, the addition of detector noise to the scanned output, Gaussian smoothing of the data stream output, and differencing and thresholding of the data for target identification.

13. Burst and Weapon Type Data. (Data .999 - Data .1174)

Burst Event Datasets. (Data .1002 - Data .1029)

The burst event datasets have the form: event type, event time, burst position, and a pointer to the weapon type dataset. Burst altitudes must be greater than zero. Five burst events are shown in the sample data deck, each pointing to a separate weapon type (note--these bursts could also point to same weapon type dataset if that were desired).

Weapon Type Dataset. (Data .1032 - Data .1174)

The weapon type dataset contains a weapon name (BOMB-1 for example), yield and yield fractions, weapon mass and mass fractions, and pointers to the device-dependent energy spectrum data and the device-independent energy spectrum data.

The remainder of this section of the data deck consists of the various spectrum data for a nominal weapon. Other weapon characteristics can be specified in a similar manner. Two sets of special weapon characteristics are given in Ref. 1.

14. Environment Output Event. (Data .1175 - Data .1191)

This event directs the program to create specific physics outputs at specified times. The dataset contains the event type,

[1] W.S. Knapp, Weapon Output, Energy Deposition and Atmospheric Chemistry Models for ROSCOE, Vol. 2, "Weapon Output and Energy Deposition Models," December 1974 (unpublished).

the event time, the type of output desired, the number of points at which output is desired, the time interval between calculations, the end print time, the radar frequency for these calculations (if appropriate), a pointer to a grid output data set, and a space for internal storage.

The event types can be specified as FIREBALL, which means that a single point within a low-altitude fireball or on its surface will be used to compute electron densities, temperatures, and clutter albedos; or as NONE, VORTEX, CONTINUUM, or ALL, which would produce point data at the number of points specified in any or all of these regions along a horizontal line from the center of a low-altitude fireball. In addition, the user can specify the event type as HA-FIREBAL to get electron densities along a vertical line through a high-altitude fireball.

The environment output event prints at a minimum (when the type is NONE) the fireball and debris properties corresponding to formats F1, F2, F3, F4, and D1. The other output types (FIREBALL, VORTEX, CONTINUUM, ALL, HA-FIREBAL) also provide the chemistry and albedo data given in the CO format dataset.

An example of the use of grid output dataset is shown in cards 1187-1191 of the sample data package. The grid output dataset is designed to provide contour plot output at selected cross sections of the grid. The variable "type" defines the location where the grid cut is made; in the example, the type is FIREBALL, indicating that a cut through the center of the fireball will be made; otherwise the type should be input as OTHER and the second variable, "index" will be used to define the index of the cell in the x- or y- direction to be used. The "kind of output" can be RHO for mass density contour plots, NE for electron density plots, STRI for striation fraction plots, ALL for all of the above, or NONE for none of them.

15. Stop Event. (Data .1192 - Data .1194)

The stop event terminates program execution at the time specified.

APPENDIX A

ROSCOE DATA PACKAGE

```
DATA     *DECK DATA                                                                    DATA        1     A
DATA     ROSCOE**  NEW VERSION OF NUCLEAR PHENOMENOLOGY CODE*                          DATA        2     A
DATA     02 TEST RUN FOR ROSCOE PROGRAM                                                DATA        3     A
DATA     IS EARTH ROTATING FOR THIS RUN          YES                                   DATA        4     A
DATA     STARTING RANDOM NUMBER                  2.7192                                DATA        5     A
DATA     *   SCALE FACTORS USED IN ROSCOE DATA (STANDARD UNITS ARE CGS)     BOX PAGE   DATA        6     A
DATA     *  SCALE FACTOR CHANGES TO CONVERT INTO CGS SYSTEM                 PRINT      DATA        7     A
DATA     CONVERSION TO MHZ                       MHZ       1000000.         SCALE      DATA        8     A
DATA     CONVERSION TO KHZ                       KHZ       1000.            SCALE      DATA        9     A
DATA     FRACTIONAL HOURS                        HRS       1.0              SCALE      DATA       10     A
DATA     KILOGRAM INPUTS                         KG        1000.0           SCALE      DATA       11     A
DATA     GRAM INPUTS                             GM        1.0              SCALE      DATA       12     A
DATA     CENTIMETER INPUTS                       CM        1.0              SCALE      DATA       13     A
DATA     *  HERE WE REDEFINE THE APPROPRIATE SCALE FACTORS BUILT INTO FLEXRED PRINT    DATA       14     A
DATA     FEET TO CENTIMETERS                     FT        30.48006         SCALE      DATA       15     A
DATA     PSF TO GM/CM**2                         PSF       .4882405         SCALE      DATA       16     A
DATA     KILOMETERS TO CENTIMETERS               KM        100000.0         SCALE      DATA       17     A
DATA     NAUTICAL MILES TO CENTIMETERS           NMI       185325.0         SCALE      DATA       18     A
DATA     POUNDS TO GRAMS                         LB        453.592          SCALE      DATA       19     A
DATA     ACCELERATION UNITS                      G         980.665          SCALE      DATA       20     A
DATA     METERS TO CENTIMETERS                   M         100.0            SCALE      DATA       21     A
DATA     METERS**2 TO CENTIMETERS**2             MSQ       10000.0          SCALE      DATA       22     A
DATA     KILOFEET TO CENTIMETERS                 KFT       30480.06         SCALE      DATA       23     A
DATA     MEGATON - THE FUNDAMENTAL YIELD UNIT    MT        1.0              SCALE      DATA       24     A
DATA     NAUTICAL MILES TO CENTIMETERS           NM        1.85E+05         SCALE      DATA       25     A
DATA     KILOTONS TO MEGATONS                    KT        .001             SCALE      DATA       26     A
DATA     KILOMETERS ON SQUARE METERS             KMSQM     10000.0          SCALE      DATA       27     A
DATA     NAUTICAL MILES RANGE ON 1 SQ. METER     NMSQM     1.85E4           SCALE      DATA       28     A
DATA     KILOFEET ON SQUARE METERS               KFSQM     3048.006         SCALE      DATA       29     A
DATA     WATTS TO ERGS/SEC                       WATTS     10000000.        SCALE      DATA       30     A
DATA     INCHES**2 TO CM**2                      INSQ      6.4516           SCALE      DATA       31     A
DATA     FT**2 TO CM**2                          FTSQ      929.0304         SCALE      DATA       32     A
DATA     *   THIS IS THE BASIC DATASET FOR ROSCOE                           BOX PAGE   DATA       33     A
DATA     ROSCOE BASIC DATA SET                                              BASIC      DATA       34     A
DATA     ROSCOE BASIC DATA SET                                              BEG SET    DATA       35     A
DATA     EVENT LIST                                                         REFER      DATA       36     A
DATA     OUTPUT SUMMARY DATASET                                             REFER      DATA       37     A
DATA     OVERLAY STRUCTURE DATASET                                          REFER      DATA       38     A
DATA     INSTRUCTIONS FOR INTERNAL OUTPUTS                                  REFER      DATA       39     A
DATA               SPACE FOR OBJECT LIST         1.0                        ZEROS      DATA       40     A
DATA               SPACE FOR RADAR LIST          1.0                        ZEROS      DATA       41     A
DATA     AD HOC DATA SET FOR TRACKER INITIALIZATION                         REFER      DATA       42     A
DATA     SPACE FOR THE BURST LIST                1.0                        ZEROS      DATA       43     A
DATA     SPACE FOR FIREBALL LIST                 1.0                        ZEROS      DATA       44     A
DATA     SPACE FOR *CONST*                       0.0                                   DATA       45     A
DATA     SPACE FOR *FRLIS* (LAMB)                0.0                                   DATA       46     A
DATA     SPACE FOR *FRLIS*  (HEAVE)              0.0                                   DATA       47     A
DATA     SPACE FOR OFSET                         1.0                        ZEROS      DATA       48     A
DATA     SPACE FOR MAGNETIC FIELD DATASET        1.0                        ZEROS      DATA       49     A
DATA     HEAVE COORDINATE DATASET                                           REFER      DATA       50     A
DATA     SHOULD WE TURN ON HYDRC FOR LA FBS      NO                                    DATA       51     A
DATA     DO YOU WANT STRIATION CALCULATIONS      YES                                   DATA       52     A
DATA    DO YOU WANT PRINTER PLOTS OF MAFB=S       YES                                       DATA        53     A
DATA    SPACE FOR INTERNAL USE                    2.0                         ZEROS         DATA        54     A
DATA    DO YOU WANT FB DATA RELATIVE TO RADAR     NO                                        DATA        55     A
DATA             SENSOR NETTING                   NO                                        DATA        56     A
DATA    DO YOU WANT TIME INTERPOLATION            NO                                        DATA        57     A
DATA    SPACE FOR OPTICAL SENSOR LIST             1.0                         ZEROS         DATA        58     A
DATA    SPACE FOR OPTICAL MEASUREMENTS            1.0                         ZEROS         DATA        59     A
DATA    BASIC CLOUD DATASET                       1.0                         ZEROS         DATA        60     A
DATA             OPTICS CALC SPEED OPTION         SLOW                                      DATA        61     A
DATA             EVPROC OUTPUT SUPPRESS FLAG      1.         INT                            DATA        62     A
DATA             OVERLAY SEP, FILE FLAG           1.0        INT                            DATA        63     A
DATA    *   FLAGS FOR TURNING ON DEBUG PRINTOUT BY OVERLAY                    BOX PAGE      DATA        64     A
DATA    INSTRUCTIONS FOR INTERNAL OUTPUTS                                     BEG SET       DATA        65     A
DATA    EVENT 1 OUTPUT                            NO                                        DATA        66     A
DATA    EVENT 2 OUTPUT                            NO                                        DATA        67     A
DATA    EVENT 3 OUTPUT                            NO                                        DATA        68     A
DATA    EVENT 4 OUTPUT                            NO                                        DATA        69     A
DATA    EVENT 5 OUTPUT                            NO                                        DATA        70     A
DATA    EVENT 6 OUTPUT                            NO                                        DATA        71     A
DATA    EVENT 7 OUTPUT                            NO                                        DATA        72     A
DATA    EVENT 8 OUTPUT                            NO                                        DATA        73     A
DATA    EVENT 9 OUTPUT                            NO                                        DATA        74     A
DATA    EVENT 10 OUTPUT                           NO                                        DATA        75     A
DATA    EVENT 11 OUTPUT                           NO                                        DATA        76     A
DATA    EVENT 12 OUTPUT                           NO                                        DATA        77     A
DATA    EVENT 13 OUTPUT                           NO                                        DATA        78     A
DATA    EVENT 14 OUTPUT                           NO                                        DATA        79     A
DATA    EVENT 15 OUTPUT                           NO                                        DATA        80     A
DATA    EVENT 16 OUTPUT                           NO                                        DATA        81     A
DATA    EVENT 17 OUTPUT                           NO                                        DATA        82     A
DATA    EVENT 18 OUTPUT                           NO                                        DATA        83     A
DATA    EVENT 19 OUTPUT                           NO                                        DATA        84     A
DATA    EVENT 20 OUTPUT                           NO                                        DATA        85     A
DATA    EVENT 21 OUTPUT                           NO                                        DATA        86     A
DATA    EVENT 22 OUTPUT                           NO                                        DATA        87     A
DATA    EVENT 23 OUTPUT                           NO                                        DATA        88     A
DATA    EVENT 24 OUTPUT                           NO                                        DATA        89     A
DATA    EVENT 25 OUTPUT                           NO                                        DATA        90     A
DATA    EVENT 26 OUTPUT                           NO                                        DATA        91     A
DATA    EVENT 27 OUTPUT                           NO                                        DATA        92     A
DATA    EVENT 28 OUTPUT                           NO                                        DATA        93     A
DATA    EVENT 29 OUTPUT                           NO                                        DATA        94     A
DATA    EVENT 30 OUTPUT                           NO                                        DATA        95     A
DATA    EVENT 31 OUTPUT                           NO                                        DATA        96     A
DATA    EVENT 32 OUTPUT                           NO                                        DATA        97     A
DATA    *   OVERLAY CALLING STRUCTURE (ALTERNATE OVERLAYS CAN BE CALLED HERE) BOX PAGE      DATA        98     A
DATA    OVERLAY STRUCTURE DATASET                                             BEG SET       DATA        99     A
DATA    EVENT 1 CALLS OVERLAY                     1.0        INT                            DATA       100     A
DATA    EVENT 2 CALLS OVERLAY                     2.0        INT                            DATA       101     A
DATA    EVENT 3 CALLS OVERLAY                     3.0        INT                            DATA       102     A
DATA    EVENT 4 CALLS OVERLAY                     4.0        INT                            DATA       103     A
DATA    EVENT 5 CALLS OVERLAY                     5.0        INT                            DATA       104     A
DATA     EVENT 6 CALLS OVERLAY              6,0      INT                        DATA     105    A
DATA     EVENT 7 CALLS OVERLAY              7,0      INT                        DATA     106    A
DATA     EVENT 8 CALLS OVERLAY              8,0      INT                        DATA     107    A
DATA     EVENT 9 CALLS OVERLAY              9,0      INT                        DATA     108    A
DATA     EVENT 10 CALLS OVERLAY             10,0     INT                        DATA     109    A
DATA     EVENT 11 CALLS OVERLAY             11,0     INT                        DATA     110    A
DATA     EVENT 12 CALLS OVERLAY             12.      INT                        DATA     111    A
DATA     EVENT 13 CALLS OVERLAY             13.      INT                        DATA     112    A
DATA     EVENT 14 CALLS OVERLAY             14,0     INT                        DATA     113    A
DATA     EVENT 15 CALLS OVERLAY             15,0     INT                        DATA     114    A
DATA     EVENT 16 CALLS OVERLAY             16,0     INT                        DATA     115    A
DATA     EVENT 17 CALLS OVERLAY             17,0     INT                        DATA     116    A
DATA     EVENT 18 CALLS OVERLAY             18,0     INT                        DATA     117    A
DATA     EVENT 19 CALLS OVERLAY             19,0     INT                        DATA     118    A
DATA     EVENT 20 CALLS OVERLAY             20,0     INT                        DATA     119    A
DATA     EVENT 21 CALLS OVERLAY             21,0     INT                        DATA     120    A
DATA     EVENT 22 CALLS OVERLAY             22,0     INT                        DATA     121    A
DATA     EVENT 23 CALLS OVERLAY             23,0     INT                        DATA     122    A
DATA     EVENT 24 CALLS OVERLAY             24,0     INT                        DATA     123    A
DATA     EVENT 25 CALLS OVERLAY             25.      INT                        DATA     124    A
DATA     EVENT 26 CALLS OVERLAY             26.      INT                        DATA     125    A
DATA     EVENT 27 CALLS OVERLAY             27.      INT                        DATA     126    A
DATA     EVENT 28 CALLS OVERLAY             28.      INT                        DATA     127    A
DATA     EVENT 29 CALLS OVERLAY             29.      INT                        DATA     128    A
DATA     EVENT 30 CALLS OVERLAY             30.      INT                        DATA     129    A
DATA     EVENT 31 CALLS OVERLAY             31.      INT                        DATA     130    A
DATA     EVENT 32 CALLS OVERLAY             32.      INT                        DATA     131    A
DATA     *   OUTPUT DATASETS AND FORMATS (MAY BE CHANGED BY USER)     BOX PAGE  DATA     132    A
DATA     OUTPUT SUMMARY DATASET                                       BEG SET   DATA     133    A
DATA     SYSTEM OUTPUT LIST                                           REFER     DATA     134    A
DATA     TRAJECTORY OUTPUT FORMAT LIST                                REFER     DATA     135    A
DATA     TRACK MEAS. ERRORS FORMAT LIST                               REFER     DATA     136    A
DATA     TRACK FILE OUTPUT FORMAT LIST                                REFER     DATA     137    A
DATA     PROPAGATION OUTPUT FORMAT LIST                               REFER     DATA     138    A
DATA     DISCRIMINATION OUTPUT FORMAT LIST                            REFER     DATA     139    A
DATA     FIREBALL POSITION OUTPUT FORMAT LIST                         REFER     DATA     140    A
DATA     BO OUTPUT LIST                     1,0                       ZEROS     DATA     141    A
DATA     F1 OUTPUT LIST                     1,0                       ZEROS     DATA     142    A
DATA     F2 OUTPUT LIST                     1,0                       ZEROS     DATA     143    A
DATA     F3 OUTPUT LIST                     1,0                       ZEROS     DATA     144    A
DATA     F4 OUTPUT LIST                     1,0                       ZEROS     DATA     145    A
DATA     D1 OUTPUT LIST                     1,0                       ZEROS     DATA     146    A
DATA     BE OUTPUT LIST                     1,0                       ZEROS     DATA     147    A
DATA     CO OUTPUT LIST                     1,0                       ZEROS     DATA     148    A
DATA     OM OUTPUT LIST                     1,0                       ZEROS     DATA     149    A
DATA     CS OUTPUT LIST                     1,0                       ZEROS     DATA     150    A
DATA     OP OUTPUT LIST                     1,0                       ZEROS     DATA     151    A
DATA     OC OUTPUT LIST                     1,0                       ZEROS     DATA     152    A
DATA     BO OUTPUT FORMAT LIST                                        REFER     DATA     153    A
DATA     F1 OUTPUT FORMAT LIST                                        REFER     DATA     154    A
DATA     F2 OUTPUT FORMAT LIST                                        REFER     DATA     155    A
DATA     F3 OUTPUT FORMAT LIST                                        REFER     DATA     156    A
DATA     F4 OUTPUT FORMAT LIST                                              REFER      DATA      157     A
DATA     D1 OUTPUT FORMAT LIST                                              REFER      DATA      158     A
DATA     BE OUTPUT FORMAT LIST                                              REFER      DATA      159     A
DATA     CC OUTPUT FORMAT LIST                                              REFER      DATA      160     A
DATA     CM OUTPUT FORMAT LIST                                              REFER      DATA      161     A
DATA     OS OUTPUT FORMAT LIST                                              REFER      DATA      162     A
DATA     CP OUTPUT FORMAT LIST                                              REFER      DATA      163     A
DATA     CC OUTPUT FORMAT LIST                                              REFER      DATA      164     A
DATA     TRAJECTORY OUTPUT FORMAT LIST                                      BEG LIST   DATA      165     A
DATA     TRAJECTORY OUTPUT FORMAT                                           REFER      DATA      166     A
DATA     TRACK MEAS, ERRORS FORMAT LIST                                     BEG LIST   DATA      167     A
DATA     TRACK MEASUREMENT ERRORS FORMAT                                    REFER      DATA      168     A
DATA     TRACK FILE OUTPUT FORMAT LIST                                      BEG LIST   DATA      169     A
DATA     TRACK FILE OUTPUT FORMAT                                           REFER      DATA      170     A
DATA     PROPAGATION OUTPUT FORMAT LIST                                     BEG LIST   DATA      171     A
DATA     PROPAGATION OUTPUT FORMAT                                          REFER      DATA      172     A
DATA     DISCRIMINATION OUTPUT FORMAT LIST                                  BEG LIST   DATA      173     A
DATA     DISCRIMINATION OUTPUT FORMAT                                       REFER      DATA      174     A
DATA     FIREBALL POSITION OUTPUT FORMAT LIST                               BEG LIST   DATA      175     A
DATA     FIREBALL POSITION OUTPUT FORMAT                                    REFER      DATA      176     A
DATA     BO OUTPUT FORMAT LIST                                              BEG LIST   DATA      177     A
DATA     BO OUTPUT FORMAT DATASET                                           REFER      DATA      178     A
DATA     F1 OUTPUT FORMAT LIST                                              BEG LIST   DATA      179     A
DATA     F1 OUTPUT FORMAT DATASET                                           REFER      DATA      180     A
DATA     F2 OUTPUT FORMAT LIST                                              BEG LIST   DATA      181     A
DATA     F2 OUTPUT FORMAT DATASET                                           REFER      DATA      182     A
DATA     F3 OUTPUT FORMAT LIST                                              BEG LIST   DATA      183     A
DATA     F3 OUTPUT FORMAT DATASET                                           REFER      DATA      184     A
DATA     F4 OUTPUT FORMAT LIST                                              BEG LIST   DATA      185     A
DATA     F4 OUTPUT FORMAT DATASET                                           REFER      DATA      186     A
DATA     D1 OUTPUT FORMAT LIST                                              BEG LIST   DATA      187     A
DATA     D1 OUTPUT FORMAT DATASET                                           REFER      DATA      188     A
DATA     BE OUTPUT FORMAT LIST                                              BEG LIST   DATA      189     A
DATA     BE OUTPUT FORMAT DATASET                                           REFER      DATA      190     A
DATA     CO OUTPUT FORMAT LIST                                              BEG LIST   DATA      191     A
DATA     CC OUTPUT FORMAT DATASET                                           REFER      DATA      192     A
DATA     CM OUTPUT FORMAT LIST                                              BEG LIST   DATA      195     A
DATA     CM OUTPUT FORMAT DATASET                                           REFER      DATA      196     A
DATA     OS OUTPUT FORMAT LIST                                              BEG LIST   DATA      197     A
DATA     OS OUTPUT FORMAT DATASET                                           REFER      DATA      198     A
DATA     CP OUTPUT FORMAT LIST                                              BEG LIST   DATA      199     A
DATA     CP OUTPUT FORMAT DATASET                                           REFER      DATA      200     A
DATA     CC OUTPUT FORMAT LIST                                              BEG LIST   FIX         1     A
DATA     CC OUTPUT FORMAT DATASET                                           REFER      FIX         2     A
DATA     *  AND NOW FOR THE INDIVIDUAL OUTPUT INSTRUCTIONS                  PRINT      DATA      201     A
DATA     TRACK FILE OUTPUT FORMAT                                           BEG SET    DATA      202     A
DATA     TYPE OF OUTPUT REQUESTED                  OUTCOL                              DATA      203     A
DATA                          TRACKING ERRORS                               TITLE      DATA      204     A
DATA     TIME COLUMN                    01014,0    TIME   OF OUTPUT SEC     OUTCOL     DATA      205     A
DATA     POSITION ERRORS               004024    ERRORS IN  ALONG V  M      OUTCOL     DATA      206     A
DATA     POSITION ERRORS               03034     POSITION==PERP TO V M      OUTCOL     DATA      207     A
DATA     POSITION ERRORS               02044     ========== ACROSS V M      OUTCOL     DATA      208     A
DATA      VELOCITY ERRORS                    07054   ERRORS  IN ALONG V  M         OUTCOL   DATA      209    A
DATA      VELOCITY ERRORS                    06064   VELOCITY-- PERP TO VM         OUTCOL   DATA      210    A
DATA      VELOCITY ERRORS                    05074   ---------- CROSS V  M         OUTCOL   DATA      211    A
DATA      TARGET POSITION                    08084     APPARENT  RANGE   M         OUTCOL   DATA      212    A
DATA      TARGET POSITION                    09094     TARGET   AZIMUTH  DEG       OUTCOL   DATA      213    A
DATA      TARGET POSITION                    10004   POSITION  ELEVATION DEG       OUTCOL   DATA      214    A
DATA      TRAJECTORY OUTPUT FORMAT                                                 BEG SET  DATA      215    A
DATA      TYPE OF OUTPUT REQUESTED                   OUTCOL                                 DATA      216    A
DATA                             TRAJECTORY OUTPUT                                 TITLE    DATA      217    A
DATA      EVENT TYPE                         01019      TYPE    OF EVENT           OUTCOL   DATA      218    A
DATA      TIME OF OUTPUT                     02024      TIME   OF OUTPUT SEC       OUTCOL   DATA      219    A
DATA      ALTITUDE                           03034     POSITION ALTITUDE M         OUTCOL   DATA      220    A
DATA      RANGE                              04044    DATA FOR   RANGE   M         OUTCOL   DATA      221    A
DATA      AZIMUTH                            05054   OBJECT AT  AZIMUTH  DEG       OUTCOL   DATA      222    A
DATA      ELEVATION                          06064   SPECIFIED ELEVATION DEG       OUTCOL   DATA      223    A
DATA      VELOCITY                           07074   TIME------ VELOCITY M         OUTCOL   DATA      224    A
DATA      SIGNAL TO NOISE                    08084   ----------SIGNAL TO NOISE (DB)OUTCOL   DATA      225    A
DATA      NUMBER OF TARGETS                  09096   NUMBER OF  TARGETS            OUTCOL   DATA      226    A
DATA      TRACK MEASUREMENT ERRORS FORMAT                                          BEG SET  DATA      227    A
DATA      TYPE OF OUTPUT REQUESTED                   OUTCOL                                 DATA      228    A
DATA                             TRACK MEASUREMENT ERRORS                          TITLE    DATA      229    A
DATA      TIME OF OUTPUT                     01014      TIME   OF OUTPUT SEC       OUTCOL   DATA      230    A
DATA      PREDICTED RANGE                    02024   PREDICTED   RANGE   M         OUTCOL   DATA      231    A
DATA      PREDICTED AZIMUTH                  03034   PREDICTED  AZIMUTH  DEG       OUTCOL   DATA      232    A
DATA      PREDICTD ELEVATION                 04044   PREDICTED ELEVATION DEG       OUTCOL   DATA      233    A
DATA      MEASURED RANGE                     05054    MEASURED   RANGE   M         OUTCOL   DATA      234    A
DATA      MEASURED AZIMUTH                   06064    MEASURED  AZIMUTH  DEG       OUTCOL   DATA      235    A
DATA      MEASURED ELEVATION                 07074    MEASURED ELEVATION DEG       OUTCOL   DATA      236    A
DATA      RANDOM ERRORS                      08084       RANDOM  RANGE   M         OUTCOL   DATA      237    A
DATA      RANDOM ERRORS                      09094   ERRORS--IN AZIMUTH  DEG       OUTCOL   DATA      238    A
DATA      RANDOM ERRORS                      10004   HAE COURLSELEVATION DEG       OUTCOL   DATA      239    A
DATA      PROPAGATION OUTPUT FORMAT                                                BEG SET  DATA      240    A
DATA      TYPE OF OUTPUT REQUESTED                   OUTCOL                                 DATA      241    A
DATA                             PROPAGATION OUTPUT                                TITLE    DATA      242    A
DATA      TIME OF OUTPUT                     01014      TIME   OF OUTPUT SEC       OUTCOL   DATA      243    A
DATA      ABSORPTION FROM ALL SOURCES        02024   ABSORPTION FROM ALL  SOURCES  OUTCOL   DATA      244    A
DATA      THRESHOLD ABSORPTION               03034   THRESHOLD ABSORPTION          OUTCOL   DATA      245    A
DATA      NOISE TEMPERATURE                  04044     NOISE     TEMP.             OUTCOL   DATA      246    A
DATA      NOISE POWER                        05052     NOISE     POWER             OUTCOL   DATA      247    A
DATA      CLUTTER POWER                      06062    CLUTTER    POWER             OUTCOL   DATA      248    A
DATA      CLUTTER-TO-NOISE RATIO             06064    CLUTTER-  TO-NOISE RATIO (DB)OUTCOL   DATA      249    A
DATA      DISPERSIVE LOSS                    13074   DISPERSIVE   LOSS             OUTCOL   DATA      250    A
DATA      FARADARY ROTATION LOSS             14084    FARADAY   ROTATION    LOSS   OUTCOL   DATA      251    A
DATA      FAILURE MODE                       15099    FAILURE     MODE             OUTCOL   DATA      252    A
DATA      TIME OF OUTPUT                     01114      TIME   OF OUTPUT SEC       OUTCOL   DATA      253    A
DATA      REFRACTION                         07134         BIAS  RANGE   M         OUTCOL   DATA      254    A
DATA      REFRACTION                         08144   REFRACTION AZIMUTH  DEG       OUTCOL   DATA      255    A
DATA      REFRACTION                         09154   ERRORS     ELEVATIONDEG       OUTCOL   DATA      256    A
DATA      REFRACTION                         10174       RANDOM  RANGE   M         OUTCOL   DATA      257    A
DATA      REFRACTION                         11184   REFRACTION AZIMUTH  DEG       OUTCOL   DATA      258    A
DATA      REFRACTION                         12194   ERRORS     ELEVATIONDEG       OUTCOL   DATA      259    A
DATA      DISCRIMINATION OUTPUT FORMAT                                             BEG SET  DATA      260    A
DATA    TYPE OF OUTPUT REQUESTED              OUTCOL                                DATA      261    A
DATA                       DISCRIMINATION OUTPUT                           TITLE    DATA      262    A
DATA    TYPE                         01019       TYPE   OF DISCRIM         OUTCOL   DATA      263    A
DATA    TIME OF OUTPUT               02024       TIME   OF OUTPUT SEC      OUTCOL   DATA      264    A
DATA    ESTIMATED LENGTH             03034     ESTIMATED  LENGTH  M        OUTCOL   DATA      265    A
DATA    DEVIATION IN LENGTH          04044    DEVIATION IN LENGTH M        OUTCOL   DATA      266    A
DATA    MEASUREMENT TYPE             05059       MEAS       TYPE           OUTCOL   DATA      267    A
DATA    MINIMUM RCS                  06061     MINIMUM      RCS    MSQ     OUTCOL   DATA      268    A
DATA    ONE=WAY ATTENUATION          07071     ONE=WAY     ATTEN       DB  OUTCOL   DATA      269    A
DATA    FIREBALL POSITION OUTPUT FORMAT                                    BEG SET  DATA      270    A
DATA    TYPE OF OUTPUT                        OUTCOL                                DATA      271    A
DATA                       FB COORDINATES RELATIVE TO RADAR                TITLE    DATA      272    A
DATA    TIME OF OUTPUT               01014       TIME   OF OUTPUT SEC      OUTCOL   DATA      273    A
DATA    FIREBALL INDEX               02026     FIREBALL   INDEX            OUTCOL   DATA      274    A
DATA    FB RANGE                     03034     FIREBALL   RANGE   M        OUTCOL   DATA      275    A
DATA    FB AZIMUTH                   04044     FIREBALL  AZIMUTH  DEG      OUTCOL   DATA      276    A
DATA    FB ELEVATION                 05054     FIREBALL ELEVATION DEG      OUTCOL   DATA      277    A
DATA    FB ANGULAR EXTENT            06064    FB ANGULAR  EXTENT  DEG      OUTCOL   DATA      278    A
DATA    FB RANGE EXTENT              07074     FB RANGE   EXTENT  M        OUTCOL   DATA      279    A
DATA    RANGE CELL                   08084      RANGE      CELL   M        OUTCOL   DATA      280    A
DATA    CLUTTER TO NOISE             09094     CLUTTER=  TO=NOISE RATIO (DB)OUTCOL  DATA      281    A
DATA    INCREMENTAL ABSORPTION       10002    ABSORPTION GRADIENT  (DB/KM) OUTCOL   DATA      282    A
DATA    BO OUTPUT FORMAT DATASET                                           BEG SET  DATA      283    A
DATA            TYPE OF OUTPUT                OUTCOL                                DATA      284    A
DATA            BURST PARAMETERS                                           TITLE    DATA      285    A
DATA            TIME OF OUTPUT       01014       TIME   OF OUTPUT SEC      OUTCOL   DATA      286    A
DATA            TOTAL ENERGY         02022      TOTAL      ENERGY   (ERGS) OUTCOL   DATA      287    A
DATA            FISSION ENERGY       03032     FISSION     ENERGY   (ERGS) OUTCOL   DATA      288    A
DATA            BURST ALTITUDE       04044      BURST    ALTITUDE KM       OUTCOL   DATA      289    A
DATA            BURST POINT DENSITY  05052    BURST PT,  DENSITY   (GM/CC) OUTCOL   DATA      290    A
DATA            BURST SCALE HEIGHT   06064      SCALE      HEIGHT  KM      OUTCOL   DATA      291    A
DATA            BURST POINT TEMP     07074    BURST PT,    TEMP   (DEG K)  OUTCOL   DATA      292    A
DATA            INITIAL FB RADIUS    08084     INITIAL     RADIUS  KM      OUTCOL   DATA      293    A
DATA            TIME TO REACH 3000K  09094       TIME     TO REACH   3000K OUTCOL   DATA      294    A
DATA            TIME TO REACH 2000K  10004       TIME     TO REACH   2000K OUTCOL   DATA      295    A
DATA    F1 OUTPUT FORMAT DATASET                                           BEG SET  DATA      296    A
DATA            TYPE OF OUTPUT                OUTCOL                                DATA      297    A
DATA            FIREBALL SET=1                                             TITLE    DATA      298    A
DATA            TIME OF OUTPUT       01014       TIME   OF OUTPUT SEC      OUTCOL   DATA      299    A
DATA            FIREBALL INDEX       02026     FIREBALL   INDEX     NUMBER OUTCOL   DATA      300    A
DATA            HORIZONTAL RADIUS    03034    HORIZONTAL  RADIUS  KM       OUTCOL   DATA      301    A
DATA            VERTICAL RADIUS      04044     VERTICAL   RADIUS  KM       OUTCOL   DATA      302    A
DATA            ALTITUDE             05054      CENTER   ALTITUDE KM       OUTCOL   DATA      303    A
DATA            RISE RATE            06064       RISE      RATE   KM       OUTCOL   DATA      304    A
DATA            EXPANSION RATE       07074    EXPANSION    RATE   KM       OUTCOL   DATA      305    A
DATA            FIREBALL DENSITY     08082     FIREBALL  DENSITY   (GM/CC) OUTCOL   DATA      306    A
DATA            FIREBALL TEMP        09094     FIREBALL    TEMP    (DEG=K) OUTCOL   DATA      307    A
DATA            TIME SINCE BURST     10004    TIME SINCE  BURST   SEC      OUTCOL   DATA      308    A
DATA    F2 OUTPUT FORMAT DATASET                                           BEG SET  DATA      309    A
DATA            TYPE OF OUTPUT                OUTCOL                                DATA      310    A
DATA            FIREBALL SET=2                                             TITLE    DATA      311    A
DATA            TIME OF OUTPUT       01014       TIME   OF OUTPUT SEC      OUTCOL   DATA      312    A
DATA           FIREBALL INDEX       02026     FIREBALL   INDEX     NUMBER  OUTCOL    DATA     313    A
DATA           MINIMUM ALTITUDE     03034     MINIMUM   ALTITUDE KM        OUTCOL    DATA     314    A
DATA           MAXIMUM ALTITUDE     04044     MAXIMUM   ALTITUDE KM        OUTCOL    DATA     315    A
DATA           TILT FROM VERTICAL   05054    TILT FROM  VERTICAL DEG       OUTCOL    DATA     316    A
DATA           AXIS ROTATION (C-N) 06064       AXIS     ROTATION DEG       OUTCOL    DATA     317    A
DATA           HOR VORTEX RADIUS    07074    HOR VORTEX  RADIUS  KM        OUTCOL    DATA     318    A
DATA           VRT VORTEX RADIUS    08084    VRT VORTEX  RADIUS  KM        OUTCOL    DATA     319    A
DATA           VORTEX VOLUME        09092      VORTEX    VOLUME     (CM3)  OUTCOL    DATA     320    A
DATA           CHARACTERISTIC TIME  10004     CHARACT,     TIME    SEC     OUTCOL    DATA     321    A
DATA      F3 OUTPUT FORMAT DATASET                                         BEG SET   DATA     322    A
DATA           TYPE OF OUTPUT                OUTCOL                                  DATA     323    A
DATA           FIREBALL SET-3                                              TITLE     DATA     324    A
DATA           TIME OF OUTPUT       01014       TIME    OF OUTPUT SEC      OUTCOL    DATA     325    A
DATA           FIREBALL INDEX       02026     FIREBALL   INDEX     NUMBER  OUTCOL    DATA     326    A
DATA           X-COORDINATE         03032        X-     COORDINATE   (CM)  OUTCOL    DATA     327    A
DATA           Y-COORDINATE         04042        Y-     COORDINATE   (CM)  OUTCOL    DATA     328    A
DATA           Z-COORDINATE         05052        Z-     COORDINATE   (CM)  OUTCOL    DATA     329    A
DATA           OVAL OF CASSINI TERM 06064     OVAL OF   CASSINI  PARAMETER OUTCOL    DATA     330    A
DATA           OVAL ARM RADIUS      07074     OVAL ARM   RADIUS  KM        OUTCOL    DATA     331    A
DATA           VORTEX TEMP          08084      VORTEX     TEMP     (DEG-K) OUTCOL    DATA     332    A
DATA           FIREBALL KIND        09096     FIREBALL    KIND             OUTCOL    DATA     333    A
DATA           MERGE ID INDEX       10006      MERGE       ID      INDEX   OUTCOL    DATA     334    A
DATA      F4 OUTPUT FORMAT DATASET                                         BEG SET   DATA     335    A
DATA           TYPE OF OUTPUT                OUTCOL                                  DATA     336    A
DATA           FIREBALL SET-4                                              TITLE     DATA     337    A
DATA           TIME OF OUTPUT       01014       TIME    OF OUTPUT SEC      OUTCOL    DATA     338    A
DATA           FIREBALL INDEX       02026     FIREBALL   INDEX     NUMBER  OUTCOL    DATA     339    A
DATA           X-COORDINATE         03032        X-     COORDINATE   (CM)  OUTCOL    DATA     340    A
DATA           Y-COORDINATE         04042        Y-     COORDINATE   (CM)  OUTCOL    DATA     341    A
DATA           Z-COORDINATE         05052        Z-     COORDINATE   (CM)  OUTCOL    DATA     342    A
DATA           CELL INDEX (X-DIR,)  06066    GRID CELL   INDEX    (X-DIR,) OUTCOL    DATA     343    A
DATA           CELL INDEX (Y-DIR,)  07076    GRID CELL   INDEX    (Y-DIR,) OUTCOL    DATA     344    A
DATA           CELL INDEX (Z-DIR,)  08086    GRID CELL   INDEX    (Z-DIR,) OUTCOL    DATA     345    A
DATA           FB REL, POS, IN CELL 09094     FIREBALL  REL, POS, IN CELL  OUTCOL    DATA     346    A
DATA           FIREBALL KIND        10006     FIREBALL    KIND             OUTCOL    DATA     347    A
DATA      D1 OUTPUT FORMAT DATASET                                         BEG SET   DATA     348    A
DATA           TYPE OF OUTPUT                OUTCOL                                  DATA     349    A
DATA           DEBRIS PARAMETERS                                           TITLE     DATA     350    A
DATA           TIME OF OUTPUT       01014       TIME    OF OUTPUT SEC      OUTCOL    DATA     351    A
DATA           FIREBALL INDEX       02026     FIREBALL   INDEX     NUMBER  OUTCOL    DATA     352    A
DATA           DEBRIS INDEX NUMBER  03036      DEBRIS    INDEX     NUMBER  OUTCOL    DATA     353    A
DATA           TOTAL ENERGY         04042      TOTAL     ENERGY    (ERGS)  OUTCOL    DATA     354    A
DATA           DEBRIS ALTITUDE      05054      DEBRIS   ALTITUDE KM        OUTCOL    DATA     355    A
DATA           HORIZONTAL RADIUS    06064    HORIZONTAL  RADIUS  KM        OUTCOL    DATA     356    A
DATA           VERTICAL RADIUS      07074     VERTICAL   RADIUS  KM        OUTCOL    DATA     357    A
DATA           DEBRIS DISTRIBUTION  08084      DEBRIS   DISTRIB, PARAMETER OUTCOL    DATA     358    A
DATA           EQUIVALENT SPH, RAD, 09094    EQUIVALENTSPH, RAD, KM        OUTCOL    DATA     359    A
DATA           DEBRIS VOLUME        10002      DEBRIS    VOLUME     (CM3)  OUTCOL    DATA     360    A
DATA      BE OUTPUT FORMAT DATASET                                         BEG SET   DATA     361    A
DATA           TYPE OF OUTPUT                OUTCOL                                  DATA     362    A
DATA           BETA TUBE PARAMETERS                                        TITLE     DATA     363    A
DATA           TIME OF OUTPUT       01014       TIME    OF OUTPUT SEC      OUTCOL    DATA     364    A
DATA          FIREBALL INDEX NUMBER02026      FIREBALL   INDEX     NUMBER  OUTCOL     DATA        365     A
DATA          BETATUBE SHAPE        03039      BETATUBE   SHAPE             OUTCOL     DATA        366     A
DATA          INITIAL DIP ANGLE     04044      INITIAL  DIP ANGLE DEG       OUTCOL     DATA        367     A
DATA          KINK ANGLE            05054     KINK ANGLEFROM HORIZDEG       OUTCOL     DATA        368     A
DATA          KINK-BURST DISTANCE   06064     KINK-BURST DISTANCE KM        OUTCOL     DATA        369     A
DATA          N-S RADIUS AT 85KM    07074     N-S RADIUS AT 85KM  KM        OUTCOL     DATA        370     A
DATA          E-W RADIUS AT 85KM    08084     E-W RADIUS AT 85KM  KM        OUTCOL     DATA        371     A
DATA          N-S RADIUS AT 60KM    09094     N-S RADIUS AT 60KM  KM        OUTCOL     DATA        372     A
DATA          E-W RADIUS AT 60KM    10004     E-W RADIUS AT 60KM  KM        OUTCOL     DATA        373     A
DATA     CO OUTPUT FORMAT DATASET                                           BEG SET    DATA        374     A
DATA          TYPE OF OUTPUT                  OUTCOL                                   DATA        375     A
DATA          DETAILED CHEMISTRY, REFLECTIVITY, AND ABSORPTION DATA         TITLE      DATA        376     A
DATA          TIME OF OUTPUT        01014        TIME   OF OUTPUT SEC       OUTCOL     DATA        377     A
DATA          FIREBALL INDEX        02026      FIREBALL   INDEX     NUMBER  OUTCOL     DATA        378     A
DATA          ALTITUDE OF POINT     03034      ALTITUDE  OF POINT KM        OUTCOL     DATA        379     A
DATA          RANGE FROM FB CENTER  04044     RANGE FROMFB CENTER KM        OUTCOL     DATA        380     A
DATA          LOCATION OF POINT     05059      LOCATION  OF POINT           OUTCOL     DATA        381     A
DATA          ELECTRON DENSITY      06062      ELECTRON  DENSITY    (CM-3)  OUTCOL     DATA        382     A
DATA          POSITIVE ION DENSITY  07072      POSITIVE  ION DENS,  (CM-3)  OUTCOL     DATA        383     A
DATA          TEMPERATURE AT POINT  08084        TEMP    AT POINT  (DEG-K)  OUTCOL     DATA        384     A
DATA          DENSITY AT POINT      09092      DENSITY   AT POINT  (GM/CC)  OUTCOL     DATA        385     A
DATA          ABSORPTION GRADIENT   10002     ABSORPTION GRADIENT  (DB/KM)  OUTCOL     DATA        386     A
DATA     OC OUTPUT FORMAT DATASET                                           BEG SET    DATA        387     A
DATA          TYPE OF OUTPUT                  OUTCOL                                   DATA        388     A
DATA          COMMUNICATIONS OUTPUT                                         TITLE      DATA        389     A
DATA          TYPE OF OUTPUT        01019        TYPE   OF OUTPUT           OUTCOL     DATA        390     A
DATA          TIME OF OUTPUT        02024        TIME   OF OUTPUT SEC       OUTCOL     DATA        391     A
DATA          UPLINK LOSS FACTOR    04034       UPLINK     LOSS     FACTOR  OUTCOL     DATA        392     A
DATA          UPLINK SCINT.         07041       UPLINK     SCINT            OUTCOL     DATA        393     A
DATA          DOWNLINK LOSS FACTOR  09054      DOWNLINK    LOSS     FACTOR  OUTCOL     DATA        394     A
DATA          DOWNLINK SCINT.       12061      DOWNLINK    SCINT            OUTCOL     DATA        395     A
DATA          PROB ERROR-SATELLITE  14071       PROB.    OF ERROR SATELLITE OUTCOL     DATA        396     A
DATA          PROB ERROR-GROUND     15081       PROB.    OF ERROR    GROUND OUTCOL     DATA        397     A
DATA          PROBABILITY OF ERROR  16091       PROB.    OF ERROR           OUTCOL     DATA        398     A
DATA          TIME OF OUTPUT        02114      TIME OF    OUTPUT  SEC       OUTCOL     DATA        399     A
DATA          RANGE S-FROM-T        19124       RANGE    S-FROM-T KM        OUTCOL     DATA        400     A
DATA          AZM S-FROM-T          20134      AZIMUTH   S-FROM-T DEG       OUTCOL     DATA        401     A
DATA          ELV S-FROM-T          21144      ELEVATION S-FROM-T DEG       OUTCOL     DATA        402     A
DATA          RANGE S-FROM-R        22164       RANGE    S-FROM-R KM        OUTCOL     DATA        403     A
DATA          AZM S-FROM-R          23174      AZIMUTH   S-FROM-R DEG       OUTCOL     DATA        404     A
DATA          ELV S-FROM-R          24184     ELEVATION  S-FROM-R DEG       OUTCOL     DATA        405     A
DATA     OM OUTPUT FORMAT DATASET                                           BEG SET    DATA        406     A
DATA          TYPE OF OUTPUT                  OUTCOL                                   DATA        407     A
DATA          OPTICAL MEASUREMENTS                                          TITLE      DATA        408     A
DATA          TIME OF OUTPUT        02014        TIME   OF OUTPUT SEC       OUTCOL     DATA        409     A
DATA          WAVELENGTH            04022      CENTRAL  WAVELENGTHM         OUTCOL     DATA        410     A
DATA          AZIMUTH               10032       ACTUAL    AZIMUTH  (RADIANS)OUTCOL     DATA        411     A
DATA          ELEVATION             11042     --COORDS  ELEVATION (RADIANS)OUTCOL      DATA        412     A
DATA          MEAS AZ               06052     MEASURED    AZIMUTH  (RADIANS)OUTCOL     DATA        413     A
DATA          MEAS EL               07062     --COORDS  ELEVATION (RADIANS)OUTCOL      DATA        414     A
DATA          EST AZ                08072     ESTIMATED  AZIMUTH  (RADIANS)OUTCOL      DATA        415     A
DATA          EST EL                09082     --COORDS  ELEVATION (RADIANS)OUTCOL      DATA        416     A
DATA           IRRADIANCE            15092    IRRADIANCEAT SENSOR  (W/CM2)  OUTCOL    DATA     417   A
DATA           SIGNAL=TO=NOISE       19002     SIGNAL=   TO=NOISE    (DB)   OUTCOL    DATA     418   A
DATA     OS OUTPUT FORMAT DATASET                                           BEG SET   DATA     419   A
DATA           TYPE OF OUTPUT                 OUTCOL                                  DATA     420   A
DATA           OPTICAL SAMPLES                                              TITLE     DATA     421   A
DATA           TIME OF OUTPUT        01013       TIME   OF OUTPUT SEC       OUTCOL    DATA     422   A
DATA           DETECTOR              02024     DETECTOR   NUMBER            OUTCOL    DATA     423   A
DATA           WAVELENGTH            03032     CENTRAL  WAVELENGTHM         OUTCOL    DATA     424   A
DATA           AZIMUTH               04042     AZIMUTH   OFF=BORE (RADIANS) OUTCOL    DATA     425   A
DATA           ELEVATION             05052    ELEVATION  OFF=BORE (RADIANS) OUTCOL    DATA     426   A
DATA           IRRADIANCE            06062      SCANNED     SIGNAL    OUTPUT  OUTCOL    DATA     427   A
DATA           NORMALIZED SIGNAL     07072    NORMALIZED   SIGNAL    OUTPUT  OUTCOL    DATA     428   A
DATA           FINAL SIGNAL          09082       FINAL      SIGNAL    OUTPUT  OUTCOL    DATA     429   A
DATA           TARGET FLAG           10099      TARGET   DETECTION   FLAG   OUTCOL    DATA     430   A
DATA     OP OUTPUT FORMAT DATASET                                           BEG SET   DATA     431   A
DATA           TYPE OF OUTPUT                 OUTCOL                                  DATA     432   A
DATA           INTEGRATED PATH DATA                                         TITLE     DATA     433   A
DATA           TIME                  01014       TIME   OF OUTPUT SEC       OUTCOL    DATA     434   A
DATA           WAVELENGTH            02022     CENTRAL  WAVELENGTHM         OUTCOL    DATA     435   A
DATA           AZIMUTH               03032     AZIMUTH   OFF=BORE (RADIANS) OUTCOL    DATA     436   A
DATA           ELEVATION             04042    ELEVATION  OFF=BORE (RADIANS) OUTCOL    DATA     437   A
DATA           RADIANCE              05052     RADIANCE (PHOTONS/ S=SR=CM2) OUTCOL    DATA     438   A
DATA           INTEGRATED RADIANCE   07062    INTEGRATED RADIANCE           OUTCOL    DATA     439   A
DATA           SIGMA DUE TO STRCTR   08072    SIGMA DUE TO STRCTR           OUTCOL    DATA     440   A
DATA     *  THE EVENT LIST INCLUDING==                                      BOX PAGE  DATA     441   A
DATA     *         ATTACK GENERATION                                        BOX       DATA     442   A
DATA     *         RADAR                                                    BOX       DATA     443   A
DATA     *         COMMUNICATION                                            BOX       DATA     444   A
DATA     *         OPTICS                                                   BOX       DATA     445   A
DATA     *         BURSTS                                                   BOX       DATA     446   A
DATA     *         ENVIRONMENT OUTPUT                                       BOX       DATA     447   A
DATA     EVENT LIST                                                         BEG LIST  DATA     448   A
DATA     ATTACK GENERATION DATASET                                          REFER     DATA     449   A
DATA     RADAR EVENT                                                        REFER     DATA     450   A
DATA     COMMUNICATIONS EVENT DATASET                                       REFER     DATA     451   A
DATA     OPTICS LOCK EVENT                                                  REFER     DATA     452   A
DATA     BURST EVENT DATASET=1                                              REFER     DATA     453   A
DATA     BURST EVENT DATASET=2                                              REFER     DATA     454   A
DATA     BURST EVENT DATASET=3                                              REFER     DATA     455   A
DATA     BURST EVENT DATASET=4                                              REFER     DATA     456   A
DATA     BURST EVENT DATASET=5                                              REFER     DATA     457   A
DATA     ENVIRONMENT OUTPUT EVENT                                           REFER     DATA     458   A
DATA     STOP EVENT                                                         REFER     DATA     459   A
DATA     *   THE ATTACK GENERATION EVENT INCLUDING INITIALIZATION ==        BOX PAGE  DATA     460   A
DATA     ATTACK GENERATION DATASET                                          BEG SET   DATA     461   A
DATA         TYPE OF EVENT                    1,0       INT                           DATA     462   A
DATA         TIME OF EVENT (DUMMY)            =5000,0   SEC                           DATA     463   A
DATA     ATTACK TYPE DATASET                                                REFER     DATA     464   A
DATA     LAUNCH POINT LIST                                                  REFER     DATA     465   A
DATA     TARGET POINT LIST                                                  REFER     DATA     466   A
DATA     *  ATTACK TYPE DATASET                                             BOX       DATA     467   A
DATA     ATTACK TYPE DATASET                                                BEG SET   DATA     468   A
DATA      TYPE OF ATTACK TO BE GENERATED          UNIFORM                                  DATA        469       A
DATA       IS IT DAY OR NIGHT FOR B.O. CALCULS.  DAY                                      DATA        470       A
DATA     DAY OF ATTACK                            23        INT                            DATA        471       A
DATA     MONTH OF ATTACK                          9         INT                            DATA        472       A
DATA     YEAR OF ATTACK     (1900 AND-----        73        INT                            DATA        473       A
DATA     TIME OF DAY                              15.45     HRS                            DATA        474       A
DATA              REF ALT                         200.      KM                             DATA        475       A
DATA              REF LAT                         47.75     DEG                            DATA        476       A
DATA              REF LONG                        -79.33    DEG                            DATA        477       A
DATA     INITIALIZATION FLAG                      0.        INT                            DATA        478       A
DATA               REGION TYPE (1=RURAL)          1.        INT                            DATA        479       A
DATA               VISABILTITY (1=50KM)           1.        INT                            DATA        480       A
DATA               MSM                            1.        INT                            DATA        481       A
DATA               DD                             .01                                      DATA        482       A
DATA     * THE LAUNCH POINTS                                                    BOX        DATA        483       A
DATA     LAUNCH POINT LIST                                                      BEG LIST   DATA        484       A
DATA     THE LANCHOU LAUNCHERY                                                  REFER      DATA        485       A
DATA     *  HEREWITH THE INDIVIDUAL LAUNCH POINTS THEMSELVES ------------------ PRINT      DATA        486       A
DATA     REFERENCE FOR LAUNCH POINT                                             BEG SET    DATA        487       A
DATA     COORD CENTER                             0.        -79.33    47.75     GEOGR      DATA        488       A
DATA     THE LANCHOU LAUNCHERY                                                  BEG SET    DATA        489       A
DATA       NAME OF LAUNCH POINT                   LANCHOU                                  DATA        490       A
DATA              LAUNCH PT                       0.        105.      36.       GEOGR      DATA        491       A
DATA     BOOSTER TYPE NO.1                                                      REFER      DATA        492       A
DATA     OBJECT TYPE A                                                          REFER      DATA        493       A
DATA              NUMBER OBJECTS                  0.        INT                            DATA        494       A
DATA       (INTERNALLY USED)                      0.0                                      DATA        495       A
DATA     * THE TARGET POINTS                                                    BOX        DATA        496       A
DATA     TARGET POINT LIST                                                      BEG LIST   DATA        497       A
DATA       BUFFALO,NEW YORK                                                     REFER      DATA        498       A
DATA     * THE INDIVIDUAL TARGET POINTS FOLLOW         ------------------------ PRINT      DATA        499       A
DATA     REFERENCE FOR TARGET POINT                                             BEG SET    DATA        500       A
DATA     COORD CENTER                             0.        -79.33    47.75     GEOGR      DATA        501       A
DATA       BUFFALO,NEW YORK                                                     BEG SET    DATA        502       A
DATA       TARGET POINT NAME                      BUFFALO                                  DATA        503       A
DATA              TARGET PT                       0.        0.        0.        LOCXYZ     DATA        504       A
DATA              NUMBER OBJECTS                  0.        INT                            DATA        505       A
DATA              IMPACT TIME OF 1ST              2000.     SEC                            DATA        506       A
DATA              DELTA TIME BETWEEN OBJECTS      20.       SEC                            DATA        507       A
DATA       SIGMA OF ARRIVAL TIMES                 0.0                                      DATA        508       A
DATA       C.E.P. OF IMPACT LOCATION              0.0                                      DATA        509       A
DATA       MODE INDICATOR (SEE RORB2 IN TRAID)    4.0       INT                            DATA        510       A
DATA              REENTRY ANGLE                   20.       DEG                            DATA        511       A
DATA     SPACE FOR POINTER TO TARGET OUTPUT ARRAY1.0                            ZEROS      DATA        512       A
DATA     SYSTEM OUTPUT LIST                                                     BEG LIST   DATA        513       A
DATA     SYSTEM OUTPUT DATASET                                                  REFER      DATA        514       A
DATA     SYSTEM OUTPUT DATASET                                                  BEG SET    DATA        515       A
DATA              OBJECT NAME                     OBJECT 1                                 DATA        516       A
DATA              RADAR NAME                      RAD/B                                    DATA        517       A
DATA              SPACES                          6.0                           ZEROS      DATA        518       A
DATA     *        SET UP HEAVE GRID                                             BOX        DATA        519       A
DATA     REFERENCE FOR HEAVE CENTER                                             BEG SET    DATA        520       A
DATA      COORD CENTER                             0.         -79.33    47.75     GEOGR      DATA      521    A
DATA      HEAVE COORDINATE DATASET                                                BEG SET    DATA      522    A
DATA                ALTITUDE OF BOTTOM             90.        KM                             DATA      523    A
DATA                HEAVE CENTER                   0.         0.        90.       LOCXYZ     DATA      524    A
DATA                ANGULAR CELL SIZE IN X         .02                                       DATA      525    A
DATA                ANGULAR CELL SIZE IN Y         .02                                       DATA      526    A
DATA                NO VERTICAL CELLS              17.        INT                            DATA      527    A
DATA                NUMBER OF CELLS IN POS. X-DIR. 3.         INT                            DATA      528    A
DATA                NUMBER OF CELLS IN NEG. X-DIR. 3.         INT                            DATA      529    A
DATA                NUMBER OF CELLS IN POS. Y-DIR. 3.         INT                            DATA      530    A
DATA                NUMBER OF CELLS IN NEG. Y-DIR. 3.         INT                            DATA      531    A
DATA                AZIMUTH OF GRID ALIGNMENT      MAGNETIC                                  DATA      532    A
DATA                NUMBER OF CELLS IN MAG. GRID   36.        INT                            DATA      533    A
DATA                TIME AT LAST CALCULATION       -5000.     SEC                            DATA      534    A
DATA                TIME AT NEW CALCULATION        0.         SEC                            DATA      535    A
DATA                BURST FLAG (IXPLO)             0.         INT                            DATA      536    A
DATA                ENERGY CHECK FLAG (IENCHK)     0.         INT                            DATA      537    A
DATA                REZONE FLAG (IRZN)             0.         INT                            DATA      538    A
DATA                SPACE FOR CELL HEIGHTS         20.                            ZEROS      DATA      539    A
DATA                MAXIMUM ALTITUDE BEFORE REZONE 750.       KM                             DATA      540    A
DATA      * OBJECT DEPENDENT DATA                                                 BOX PAGE   DATA      541    A
DATA      *                                                                       PRINT      DATA      542    A
DATA      OBJECT LIST                                                             BEG LIST   DATA      543    A
DATA      REF=OBJECT                                                              REFER      DATA      544    A
DATA      OBJECT=1                                                                BEG SET    DATA      545    A
DATA                NAME                           OBJECT 1                                  DATA      546    A
DATA      OBJECT TYPE A                                                           REFER      DATA      547    A
DATA      OBJECT POSITION                                                         REFER      DATA      548    A
DATA                KFLG                           ALIVE                                     DATA      549    A
DATA      RADAR CROSS SECTION DATASET                                             REFER      DATA      550    A
DATA      BODY AXIS ALONG VELOCITY TUMBLING MODEL                                 REFER      DATA      551    A
DATA                FILE                           1.0                            ZEROS      DATA      552    A
DATA      REFERENCE FOR OBJECT POSITION                                           BEG SET    DATA      553    A
DATA      COORD CENTER                             0.         -79.33    47.75     GEOGR      DATA      554    A
DATA      OBJECT POSITION                                                         BEG SET    DATA      555    A
DATA                                               10.                            ZEROS      DATA      556    A
DATA                                               -10000.    SEC                            DATA      557    A
DATA                STATE TIME                     99999.     SEC                            DATA      558    A
DATA                STATE POSITION                 0.         50.       50.       LOCXYZ     DATA      559    A
DATA                STATE VELOCITY                 7.         -90.      -45.      POLAR      DATA      560    A
DATA                STATE ACCEL.                   0.         0.        0.        LOCXYZ     DATA      561    A
DATA      COLUMBUS BOOSTER BETA TABLE                                             REFER      DATA      562    A
DATA      BETA MULTIPLIER                          0.                                        DATA      563    A
DATA      REF=OBJECT                                                              BEG SET    DATA      564    A
DATA                NAME                           REF                                       DATA      565    A
DATA      OBJECT TYPE A                                                           REFER      DATA      566    A
DATA      REF OBJECT POSITION                                                     REFER      DATA      567    A
DATA                KFLG                           ALIVE                                     DATA      568    A
DATA                SPACES                         4.0                            ZEROS      DATA      569    A
DATA      REF. POSITION COORD. FOR LOCAL AXES                                     BEG SET    DATA      570    A
DATA      COORD. CENTER                            0.         -79.33    47.75     GEOGR      DATA      571    A
DATA      REF OBJECT POSITION                                                     BEG SET    DATA      572    A
DATA                                            10.                         ZEROS     DATA     573    A
DATA                                            -10000.   SEC                         DATA     574    A
DATA            STATE TIME                      0.        SEC                         DATA     575    A
DATA            POSITION                        0.        -79.33   47.75    GEOGR     DATA     576    A
DATA            VELOCITY                        3.0                         ZEROS     DATA     577    A
DATA            ACCELERATION                    3.0                         ZEROS     DATA     578    A
DATA            SPACES                          2.0                         ZEROS     DATA     579    A
DATA     *      BOOSTER TYPE DATA                                           BCX       DATA     580    A
DATA     BOOSTER TYPE NO.1                                                  BEG SET   DATA     581    A
DATA            NAME                            PLUME                                 DATA     582    A
DATA     THE LANCHCU LAUNCHERY                                              REFER     DATA     583    A
DATA     BOOSTER STAGE LIST                                                 REFER     DATA     584    A
DATA     BOOSTER STAGE LIST                                                 BEG LIST  DATA     585    A
DATA     STAGE 1                                                            REFER     DATA     586    A
DATA     STAGE 2                                                            REFER     DATA     587    A
DATA     STAGE 2                                                            BEG SET   DATA     588    A
DATA            FUEL TYPE                       LIQUID                                DATA     589    A
DATA            THRUST                          135000.   LB                          DATA     590    A
DATA            WTI                             20000.    LB                          DATA     591    A
DATA            WTF                             8000.     LB                          DATA     592    A
DATA            NOZA                            2000.     INSQ                        DATA     593    A
DATA            TBURN                           0.        SEC                         DATA     594    A
DATA            TSTEP                           5.        SEC                         DATA     595    A
DATA            REFA                            35.       FTSQ                        DATA     596    A
DATA            CX-M PAIR1            .03                 .5                TABLE     DATA     597    A
DATA             CX-M PAIR2           .136                1.0               TABLE     DATA     598    A
DATA            CX-M PAIR3            .068                3.0               TABLE     DATA     599    A
DATA     STAGE 1                                                            BEG SET   DATA     600    A
DATA            FUEL TYPE                       LIQUID                                DATA     601    A
DATA            THRUST                          1100000.  LB                          DATA     602    A
DATA            WTI                             70000.    LB                          DATA     603    A
DATA            WTF                             35000.    LB                          DATA     604    A
DATA            NOZA                            3000.     INSQ                        DATA     605    A
DATA            TBURN                           0.        SEC                         DATA     606    A
DATA            TSTEP                           1.        SEC                         DATA     607    A
DATA            REFA                            35.       FTSQ                        DATA     608    A
DATA            CX-M PAIR1            .10                 .5                TABLE     DATA     609    A
DATA            CX-M PAIR2            .19                 1.0               TABLE     DATA     610    A
DATA            CX-M PAIR3            .11                 3.0               TABLE     DATA     611    A
DATA     *      OBJECT TYPE DATA                                            BCX       DATA     612    A
DATA     OBJECT TYPE A                                                      BEG SET   DATA     613    A
DATA       NAME OF OBJECT TYPE                  OVERSHOE                              DATA     614    A
DATA     COLUMBUS BOOSTER BETA TABLE                                        REFER     DATA     615    A
DATA       RE-ENTRY ALTITUDE (WHERE DRAG STARTS) 100.0    KM                          DATA     616    A
DATA     RADAR CROSS SECTION DATASET                                        REFER     DATA     617    A
DATA     SPACE FOR BCMS                         1.0                         ZEROS     DATA     618    A
DATA     BODY AXIS ALONG VELOCITY TUMBLING MODEL                            REFER     DATA     619    A
DATA     *  OBJECT TABULATED BETA                                           BCX       DATA     620    A
DATA     COLUMBUS BOOSTER BETA TABLE                                        BEG SET   DATA     621    A
DATA            MODEL TYPE                      1.0       INT                         DATA     622    A
DATA            BETA                            1500.     PSF                         DATA     623    A
DATA     *    THE RADAR EVENT AND RADAR DATASETS **                         BCX PAGE  DATA     624    A
DATA    RADAR EVENT                                                      BEG SET    DATA     625    A
DATA            KTYPE                            4.0       INT                      DATA     626    A
DATA            TIME                             99999.    SEC                      DATA     627    A
DATA    RADAR B                                                          REFER      DATA     628    A
DATA    OBJECT-1                                                         REFER      DATA     629    A
DATA            KTRACK                           1.0                     ZEROS      DATA     630    A
DATA            KFLAG                            INITIAL                            DATA     631    A
DATA            SPACE                            2.0                     ZEROS      DATA     632    A
DATA    SYSTEM OUTPUT DATASET                                            REFER      DATA     633    A
DATA            SPACE                            6.0                     ZEROS      DATA     634    A
DATA    *       RADAR DATA                                               BCX        DATA     635    A
DATA    RADAR LIST                                                       BEG LIST   DATA     636    A
DATA    RADAR B                                                          REFER      DATA     637    A
DATA    RADAR B                                                          BEG SET    DATA     638    A
DATA             NAME                            RAD/B                              DATA     639    A
DATA    PLATFORM FOR RADAR                                               REFER      DATA     640    A
DATA    BORESIGHT FOR RADAR B                                            REFER      DATA     641    A
DATA    RADAR TYPE DATA                                                  REFER      DATA     642    A
DATA    RADAR ERRORS                                                     REFER      DATA     643    A
DATA    DISCRIMINATION INPUT DATASET                                     REFER      DATA     644    A
DATA    SPACE FOR TRACK FILE LIST HERE           1.0                     ZEROS      DATA     645    A
DATA    GEOGRAPHICAL CENTER FOR LOCAL COORDINATE SYSTEM                  BEG SET    DATA     646    A
DATA    COORD CENTER                             0.        -79.33   47.75  GEOGR    DATA     647    A
DATA    * BORESIGHT ARRAY FOR PRECEDING RADAR ---------------------------  PRINT    DATA     648    A
DATA    BORESIGHT FOR RADAR B                                            BEG SET    DATA     649    A
DATA             MAY FACE 1 ACQUIRE              YES                                DATA     650    A
DATA            BORESIGHT                        1.0E-3    90.      25.  POLAR      DATA     651    A
DATA    BORESIGHT FOR RADAR B                                            END SET    DATA     652    A
DATA    *  RADAR ERROR LIST                                              BCX        DATA     653    A
DATA    RADAR ERRORS                                                     BEG SET    DATA     654    A
DATA            FIXED ERRORS, R                  500.      FT                       DATA     655    A
DATA            FIXED ERRORS, A                  .5        MRAD                     DATA     656    A
DATA            FIXED ERRORS, E                  .8        MRAD                     DATA     657    A
DATA            S/N DEP, ERRORS, R               2400.     FT                       DATA     658    A
DATA            S/N DEP, ERRORS, A               15.       MRAD                     DATA     659    A
DATA            S/N DEP, ERRORS, E               15.       MRAD                     DATA     660    A
DATA             (SPACE FOR BIAS VALUES)         3.0                     ZEROS      DATA     661    A
DATA    *  DISCRIMINATION TYPE DATA                                      BCX        DATA     662    A
DATA    DISCRIMINATION INPUT DATASET                                     BEG SET    DATA     663    A
DATA             DISCRIMINANT                    FFL                                DATA     664    A
DATA             MAX FREQUENCY                   575.0     MHZ                      DATA     665    A
DATA             MIN FREQUENCY                   450.0     MHZ                      DATA     666    A
DATA             LENGTH                          6.        FT                       DATA     667    A
DATA             TIME INTERVAL                   1.0       SEC                      DATA     668    A
DATA             MFF                             100.      KM                       DATA     669    A
DATA    TOTAL DISCRIMINATION TIME                10.       SEC                      DATA     670    A
DATA    RANGE LIMIT FOR DISCRIMINATION           100.      KM                       DATA     671    A
DATA             NOISE BANDWIDTH                 100.0     MHZ                      DATA     672    A
DATA            SPACE FOR STATE VECTOR           10.                     ZEROS      DATA     673    A
DATA    *  RADAR TYPE DATA                                               BCX        DATA     674    A
DATA    RADAR TYPE DATA                                                  BEG SET    DATA     675    A
DATA    NAME                                     MOLEST                             DATA     676    A
DATA    FLAG FOR BEAM STACKING                     NONSTACKED                                         DATA      677    A
DATA    RADAR ERRORS                                                                        REFER     DATA      678    A
DATA    TRANSMIT BEAM SHAPE MODEL                                                           REFER     DATA      679    A
DATA    RECEIVE BEAM SHAPE MODEL                                                            REFER     DATA      680    A
DATA    SEARCH MODE PARAMETERS DATASET                                                      REFER     DATA      681    A
DATA    TRACK MODE PARAMETERS DATASET                                                       REFER     DATA      682    A
DATA                FREQUENCY                      450.        MHZ                                    DATA      683    A
DATA                 SYSTEM TEMPERATURE            720.0                                              DATA      684    A
DATA                HORIZON LIMIT                  2.          DEG                                    DATA      685    A
DATA                 OFF BORESIGHT LIMIT           60.         DEG                                    DATA      686    A
DATA    ANTENNA POLARIZATION                       NONLINEAR                                          DATA      687    A
DATA    *                                                                                   PRINT     DATA      688    A
DATA    *                                                                                   PRINT     DATA      689    A
DATA    SEARCH MODE PARAMETERS DATASET                                                      BEG SET   DATA      690    A
DATA                RANGE ON 1SQ-M                 2500.       NMSQM                                  DATA      691    A
DATA                THRESHOLD DET+VERIF            20.         DB                                     DATA      692    A
DATA                 DELAY FROM ACQ TO TRACK       .1          SEC                                    DATA      693    A
DATA                 FRAME RANDOMIZATION           NONRANDOM                                          DATA      694    A
DATA                MAX DET ALT                    1800.       NM                                     DATA      695    A
DATA                MIN DET ALT                    1.          KM                                     DATA      696    A
DATA                MAX DET RANGE                  1800.       NM                                     DATA      697    A
DATA                MIN DET RANGE                  1.          KM                                     DATA      698    A
DATA                FRAME TIME                     1.0         SEC                                    DATA      699    A
DATA                VERIFY PULSE                   1.0         SEC                                    DATA      700    A
DATA                MIN ELEV                       2.          DEG                                    DATA      701    A
DATA                 UPPER ELEVATION               85.         DEG                                    DATA      702    A
DATA                 SIDE HALF AZIMUTH             55.         DEG                                    DATA      703    A
DATA                NOISE BANDWIDTH                2.5         KHZ                                    DATA      704    A
DATA                SIGNAL BANDWIDTH               2.5         KHZ                                    DATA      705    A
DATA                PULSE COMPRESSION              1.0                                                DATA      706    A
DATA                 RANGE SIDELOBE LEVEL          -30.        DB                                     DATA      707    A
DATA                SEARCH FLAG                    1.0         INT                                    DATA      708    A
DATA    REFERECNCE FOR RADAR                                                                BEG SET   DATA      709    A
DATA    COORD CENTER                               0.          -79.33      47.75            GEOGR     DATA      710    A
DATA    PLATFORM FOR RADAR                                                                  BEG SET   DATA      711    A
DATA    TYPE                                       FIXED                                              DATA      712    A
DATA                RADAR LOCATION                 0.          0.          0.               LOCXYZ    DATA      713    A
DATA    *                                                                                   PRINT     DATA      714    A
DATA    AD HOC DATA SET FOR TRACKER INITIALIZATION                                          BEG SET   DATA      715    A
DATA                 BETA MULTIPLIER               0.0                                                DATA      716    A
DATA                 DECAY TIMES      TAU1         99999.                                             DATA      717    A
DATA                                  TAU2         99999.                                             DATA      718    A
DATA                                  M TAU        0.0                                                DATA      719    A
DATA                 BETA MULTIPLIER SIGMA START   500.0                                              DATA      720    A
DATA                 BETA DOT                      30.0                                               DATA      721    A
DATA    GUESSED BETA TABLE                                                                  REFER     DATA      722    A
DATA    GUESSED BETA TABLE                                                                  BEG SET   DATA      723    A
DATA    TYPE                                       2.0         INT                                    DATA      724    A
DATA    NUMBER OF TABULAR ENTRIES                  2.0         INT                                    DATA      725    A
DATA    N-POINT INTERPOLATION FOR NM               2.0         INT                                    DATA      726    A
DATA    TABULAR VALUES FOLLOW           10.0       KM          1500.0      PSF              TABLE     DATA      727    A
DATA                                    50.0       KM          1500.0      PSF              TABLE     DATA      728    A
DATA     *                                                                PRINT      DATA       729   A
DATA     TRANSMIT BEAM SHAPE MODEL                                        BEG SET    DATA       730   A
DATA     NAME                                       CONSTANT                         DATA       731   A
DATA     SHAPE                                      CIRCULAR                         DATA       732   A
DATA                  BEAMWIDTH                     1.5         DEG                  DATA       733   A
DATA                  HALF BEAM SINE SPACE          0.                               DATA       734   A
DATA     ELLIPTICAL HALF V VALUE                    0.0                              DATA       735   A
DATA                  NEAR-IN ANGULAR SIDELUBE LEVEL -30.       DB                   DATA       736   A
DATA                  INTERNAL STORAGE              1.0                   ZEROS      DATA       737   A
DATA     *                                                                PRINT      DATA       738   A
DATA     TRACK MODE PARAMETERS DATASET                                    BEG SET    DATA       739   A
DATA                  S/N THRESHOLD                 15.         DB                   DATA       740   A
DATA                  MIN TRACK RANGE               1.          KM                   DATA       741   A
DATA                  RANGE GATE PARM, K1           .5          KM                   DATA       742   A
DATA                                           K2   2.0                              DATA       743   A
DATA                   TOTAL TIME BEFORE DROP TRACK 10.         SEC                  DATA       744   A
DATA                  TRACK INT                     1.          SEC                  DATA       745   A
DATA                  RANGE ON 1 SQ-M               2500.       NMSQM                DATA       746   A
DATA                  RANGE GATE                    1.          KM                   DATA       747   A
DATA                  NOISE BANDWIDTH               2.5         KHZ                  DATA       748   A
DATA                  SIGNAL BANDWIDTH              .3          MHZ                  DATA       749   A
DATA                  PULSE COMPRESSION             120.                             DATA       750   A
DATA     RANGE SIDELOBE LEVEL                       -30.        DB                   DATA       751   A
DATA     RADAR CROSS SECTION DATASET                                      BEG SET    DATA       752   A
DATA                  MODEL TYPE                    1.0         INT                  DATA       753   A
DATA                  RCS                           1.0         MSQ                  DATA       754   A
DATA     BODY AXIS ALONG VELOCITY TUMBLING MODEL                          BEG SET    DATA       755   A
DATA     MODEL TYPE                                 1.0         INT                  DATA       756   A
DATA     RECEIVE BEAM SHAPE MODEL                                         BEG SET    DATA       757   A
DATA     TRANSMIT BEAM SHAPE MODEL                                        INSERT     DATA       758   A
DATA     RECEIVE BEAM SHAPE MODEL                                         END SET    DATA       759   A
DATA     *   THE COMMUNICATIONS EVENT DATASETS **                         BOX PAGE   DATA       760   A
DATA     COMMUNICATIONS EVENT DATASET                                     BEG SET    DATA       761   A
DATA                  EVENT TYPE                    22.         INT                  DATA       762   A
DATA                  EVENT TIME                    99999.      SEC                  DATA       763   A
DATA                  TRANSMITTER PLATFORM DATASET                        REFER      DATA       764   A
DATA                  SATELLITE PLATFORM DATASET                          REFER      DATA       765   A
DATA                  RECEIVER PLATFORM DATASET                           REFER      DATA       766   A
DATA                  TIME STEP                     30.         SEC                  DATA       767   A
DATA                  TYPE MOD.                     DPSK                             DATA       768   A
DATA                  REGEN.                        YES                              DATA       769   A
DATA                  COHERENT FSK                  NO                               DATA       770   A
DATA                  FULLY DET.                    YES                              DATA       771   A
DATA                  CONSTANT ZETA                 .707                             DATA       772   A
DATA                  ORDER PLL                     FIRST                            DATA       773   A
DATA                  UPLINK DATASET                                      REFER      DATA       774   A
DATA                  DOWNLINK DATASET                                    REFER      DATA       775   A
DATA     SPACE FOR INTERNAL CALCULATIONS            6.0                   ZEROS      DATA       776   A
DATA     INITIAL VALUE FOR T1                       -10.        SEC                  DATA       777   A
DATA     INITIAL VALUE FOR T2                       -10.        SEC                  DATA       778   A
DATA     SPACE FOR INTERNAL CALCULATIONS            9.                    ZEROS      DATA       779   A
DATA     *            UPLINK,DOWNLINK DATA                                BOX        DATA       780   A
DATA                UPLINK DATASET                                           BEG SET   DATA      781     A
DATA                POWER                          100.      WATTS                      DATA      782     A
DATA                FREQ                           8000.     MHZ                        DATA      783     A
DATA                TRANS. GAIN                    61.       DB                         DATA      784     A
DATA                REC. GAIN                      16.8      DB                         DATA      785     A
DATA      TRANSMITTER LOSS FACTOR                  2.5       DB                         DATA      786     A
DATA      SYSTEM LINE LOSS FACTOR                  0.5       DB                         DATA      787     A
DATA                PHASED ARRAY TRANSMITTER       NO                                   DATA      788     A
DATA                UPLINK XMTR AZIM ERROR         0.        DEG                        DATA      789     A
DATA                UPLINK XMTR ELEV ERROR         0.        DEG                        DATA      790     A
DATA      SPACE FOR BORESIGHT VECTOR               3.                        ZEROS      DATA      791     A
DATA                PHASED ARRAY RECEIVER          NO                                   DATA      792     A
DATA                UPLINK RCVR AZIM ERROR         0.        DEG                        DATA      793     A
DATA                UPLINK RCVR ELEV ERROR         0.        DEG                        DATA      794     A
DATA      SPACE FOR BORESIGHT VECTOR               3.                        ZEROS      DATA      795     A
DATA                BIT PERIOD                     1.0E-8    SEC                        DATA      796     A
DATA                IF BANDWIDTH                   125.      MHZ                        DATA      797     A
DATA                BANDWIDTH FOR PLL              125.      MHZ                        DATA      798     A
DATA                BEAMWIDTH                      1.5       DEG                        DATA      799     A
DATA                S/N THRESHOLD                  15.       DB                         DATA      800     A
DATA      SIDELOBE LEVEL                           30.       DB                         DATA      801     A
DATA                SPACE FOR BIT ERROR,PHASE ERROR2.0                       ZEROS      DATA      802     A
DATA                RECEIVER NOISE TEMPERATURE     720.                                 DATA      803     A
DATA                SPACE FOR NOISE FIGURE,TEMP    2.0                       ZEROS      DATA      804     A
DATA      SPACES FOR INTERNAL CALCULATIONS         32.                       ZEROS      DATA      805     A
DATA                DOWNLINK DATASET                                         BEG SET    DATA      806     A
DATA                POWER                          20.       WATTS                      DATA      807     A
DATA                FREQ                           7400.     MHZ                        DATA      808     A
DATA                TRANS. GAIN                    33.2      DB                         DATA      809     A
DATA                REC. GAIN                      61.       DB                         DATA      810     A
DATA      TRANSMITTER LOSS FACTOR                  3.2       DB                         DATA      811     A
DATA      SYSTEM LOSS FACTOR                       0.5       DB                         DATA      812     A
DATA                PHASE ARRAY TRANSMITTER        NO                                   DATA      813     A
DATA                DNLINK XMTR AZIM ERROR         0.        DEG                        DATA      814     A
DATA                DNLINK XMTR ELEV ERROR         0.        DEG                        DATA      815     A
DATA      SPACE FOR BORESIGHT VECTOR               3.                        ZEROS      DATA      816     A
DATA                PHASED ARRAY RECEIVER          NO                                   DATA      817     A
DATA                DNLINK RCVR AZIM ERROR         0.        DEG                        DATA      818     A
DATA                DNLINK RCVR ELEV ERROR         0.        DEG                        DATA      819     A
DATA      SPACE FOR BORESIGHT VECTOR               3.                        ZEROS      DATA      820     A
DATA                BIT PERIOD                     1.0E-8    SEC                        DATA      821     A
DATA                IF BANDWIDTH                   125.      MHZ                        DATA      822     A
DATA                BANDWIDTH PLL                  125.      MHZ                        DATA      823     A
DATA                BEAMWIDTH                      1.5       DEG                        DATA      824     A
DATA                S/N THRESHOLD                  15.       DB                         DATA      825     A
DATA      SIDELOBE LEVEL                           30.       DB                         DATA      826     A
DATA                SPACE FOR BIT ERROR,PHASE ERROR2.0                       ZEROS      DATA      827     A
DATA      RECEIVER NOISE TEMPERATURE               200.                                 DATA      828     A
DATA                SPACE FOR NOISE FIGURE,TEMP    2.0                       ZEROS      DATA      829     A
DATA      SPACES FOR INTERNAL CALCULATIONS         32.                       ZEROS      DATA      830     A
DATA      *         GROUND XMITTER,GROUND RECEIVER, AND SATELLITE POSITIONS  BOX        DATA      831     A
DATA      REF. POS. FOR COMMUNICATIONS                                       BEG SET    DATA      832     A
DATA    REFERENCE POSITION                  0.       -79.33   47.75    GEOGR     DATA     833   A
DATA            TRANSMITTER PLATFORM DATASET                               BEG SET   DATA     834   A
DATA            TYPE OF PLATFORM            FIXED                                    DATA     835   A
DATA            TRANS. POSITION             0.       0.       0.       LCCXYZ    DATA     836   A
DATA            RECEIVER PLATFORM DATASET                                  BEG SET   DATA     837   A
DATA            TYPE                        FIXED                                    DATA     838   A
DATA            REC. POSITION               0.       0.       0.       LCCXYZ    DATA     839   A
DATA            SATELLITE PLATFORM DATASET                                 BEG SET   DATA     840   A
DATA            TYPE                        FIXED                                    DATA     841   A
DATA            SAT. POSITION               0.       0.       35787.   LCCXYZ    DATA     842   A
DATA    *   THE OPTICAL SENSOR EVENT AND OPTICS DATA **                    BCX PAGE  DATA     843   A
DATA    OPTICS LOCK EVENT                                                  BEG SET   DATA     844   A
DATA            TYPE                        25.      INT                             DATA     845   A
DATA            TIME                        99999.   SEC                             DATA     846   A
DATA    OPTICAL SENSOR                                                     REFER     DATA     847   A
DATA    REF-OBJECT                                                         REFER     DATA     848   A
DATA    SPACE                               1.0                            ZEROS     DATA     849   A
DATA            KFLAG                       SET-UP                                   DATA     850   A
DATA    SPACE                               1.0                            ZEROS     DATA     851   A
DATA    *       CLOUD DATA                                                 BCX       DATA     852   A
DATA    BASIC CLOUD DATASET                                                BEG SET   DATA     853   A
DATA            MODEL TYPE                  1.       INT                             DATA     854   A
DATA            NUMBER OF CLOUDS            1.       INT                             DATA     855   A
DATA    CLOUD LIST                          1.                             ZEROS     DATA     856   A
DATA    STATISTICAL CLOUD DATASET                                          REFER     DATA     857   A
DATA    STATISTICAL CLOUD DATASET                                          BEG SET   DATA     858   A
DATA            MODEL NUMBER                1.       INT                             DATA     859   A
DATA            LAYER PARAMETER             0.       INT                             DATA     860   A
DATA            SPACES                      90.                            ZEROS     DATA     861   A
DATA    CLOUD LIST                                                         BEG LIST  DATA     862   A
DATA    CLOUD A                                                            REFER     DATA     863   A
DATA    CLOUD A                                                            BEG SET   DATA     864   A
DATA            OBJECT TYPE                 CLOUD                                    DATA     865   A
DATA            CLOUD INDEX                 1.0      INT                             DATA     866   A
DATA            CLOUD TYPE                  1.0      INT                             DATA     867   A
DATA            POSITION                    6.       82.75    51.32    GEOGR     DATA     868   A
DATA            SEMI-MAJOR HORIZ. AXIS (A)  4.       KM                              DATA     869   A
DATA            SEMI-MINOR HORIZ. AXIS (B)  4.       KM                              DATA     870   A
DATA            SEMI-MAJOR VERT. AXIS (C)   4.       KM                              DATA     871   A
DATA            ORIENTATION (A +CCW FROM EAST) 0.    DEG                             DATA     872   A
DATA    *       OPTICAL SENSOR DATA                                        BCX       DATA     873   A
DATA    OPTICAL SENSOR LIST                                                BEG LIST  DATA     874   A
DATA    OPTICAL SENSOR                                                     REFER     DATA     875   A
DATA    OPTICAL SENSOR                                                     BEG SET   DATA     876   A
DATA            NAME                        SCOPE                                    DATA     877   A
DATA            OPTICS TYPE                 TRACK                                    DATA     878   A
DATA            OPTICS CALC TYPE            FOV                                      DATA     879   A
DATA            OBJECT TYPES                ALL                                      DATA     830   A
DATA    BORESIGHT                                                          REFER     DATA     881   A
DATA    PLATFORM                                                           REFER     DATA     882   A
DATA    OPTICS TYPE                                                        REFER     DATA     883   A
DATA    OPTICS NOISE                                                       REFER     DATA     884   A
DATA     OPTICS OPTICNS                          1.0                          ZEROS     DATA     885    A
DATA     TRACK FILE                              1.0                          ZEROS     DATA     886    A
DATA     OPTICS GRID                                                          REFER     DATA     887    A
DATA     LIST OF PATHS                           1.0                          ZEROS     DATA     888    A
DATA     OPTICS NOISE                                                         BEG SET   DATA     889    A
DATA              FIXED ERRORS, AZM              .01      MRAD                          DATA     890    A
DATA              FIXED ERRORS, ELV              .01      MRAD                          DATA     891    A
DATA              S/N DEP, ERRORS, AZM           1.       MRAD                          DATA     892    A
DATA              S/N DEP, ERRORS, ELV           1.       MRAD                          DATA     893    A
DATA     SPACE FOR BIAS ERRORS                   2.0                          ZEROS     DATA     894    A
DATA     BORESIGHT                                                            BEG SET   DATA     895    A
DATA     ACQUISITION ALLOWED                     YES                                    DATA     896    A
DATA              BORESIGHT                      3.0                          ZEROS     DATA     897    A
DATA              SIGMA                          0.                                     DATA     898    A
DATA     DUMMY REF, PCS, FOR OPTICS SENSOR                                    BEG SET   DATA     899    A
DATA     REF, PCS, FOR OPTICS SENSOR             35787.   -79,33    47,75     GEOGR     DATA     900    A
DATA     PLATFORM                                                             BEG SET   DATA     901    A
DATA              TYPE                           FIXED                                  DATA     902    A
DATA              SENSOR POSITON                 35787.   -79,33    47,75     GEOGR     DATA     903    A
DATA     *        OPTICS TYPE DATA                                            BCX       DATA     904    A
DATA     OPTICS TYPE                                                          BEG SET   DATA     905    A
DATA              NAME                           STANDARD                               DATA     906    A
DATA              NUMBER OF DETECTORS            1.       INT                           DATA     907    A
DATA              DIAMETER                       2,7E-5                                 DATA     908    A
DATA              BLUR DIAMETER                  2,7E-5                                 DATA     909    A
DATA              NEFD                           .5E-16                                 DATA     910    A
DATA              NEFD BAND WIDTH                6000.                                  DATA     911    A
DATA              SPACE                          1.0                          ZEROS     DATA     912    A
DATA              FRAME TIME                     10.      SEC                           DATA     913    A
DATA              RANDOM                         NO                                     DATA     914    A
DATA              MIN UPDATE TIME                10.      SEC                           DATA     915    A
DATA              MAX UPDATE TIME                10.      SEC                           DATA     916    A
DATA     WAVELENGTH BAND LIST                                                 REFER     DATA     917    A
DATA     FIELD-OF-VIEW                                                        REFER     DATA     918    A
DATA     WAVELENGTH BAND LIST                                                 BEG LIST  DATA     919    A
DATA     WAVELENGTH BAND A                                                    REFER     DATA     920    A
DATA     WAVELENGTH BAND A                                                    BEG SET   DATA     921    A
DATA              LOW END                        2,5E-6   M                             DATA     922    A
DATA              HIGH END                       2,6E-6   M                             DATA     923    A
DATA              SPACES                         3,0                          ZEROS     DATA     924    A
DATA     WAVELENGTH BAND B                                                    BEG SET   DATA     925    A
DATA               LOW END                       2,6E-6   M                             DATA     926    A
DATA              HIGH END                       2,7E-6   M                             DATA     927    A
DATA              SPACES                         3,0                          ZEROS     DATA     928    A
DATA     FIELD-OF-VIEW                                                        BEG SET   DATA     929    A
DATA              TYPE                           SQUARE                                 DATA     930    A
DATA              AZIMUTH EXTENT                 .8E-3                                  DATA     931    A
DATA              ELEVATION EXTENT               .8E-3                                  DATA     932    A
DATA              MBAF                           60.      KM                            DATA     933    A
DATA              ABAF                           -999.                                  DATA     934    A
DATA     *        OPTICS CALCULATIONS                                         BCX       DATA     935    A
DATA     OPTICS OPTICNS                                                       BEG SET   DATA     936    A
DATA    SIMULATE OPTICS                                                   REFER     DATA      937     A
DATA    TRACK SIMULATION EVENT                  1.0                       ZEROS     DATA      938     A
DATA    SPACES                                  3.0                       ZEROS     DATA      939     A
DATA    SIMULATE OPTICS                                                   BEG SET   DATA      940     A
DATA            KTYPE                           27.           INT                   DATA      941     A
DATA            TIME                            99999.        SEC                   DATA      942     A
DATA            MODEL TYPE                      SURVEIL-01                          DATA      943     A
DATA            SCAN TYPE                       CIRCULAR                            DATA      944     A
DATA    OPTICAL SENSOR                                                    REFER     DATA      945     A
DATA            PLOTS                           OBJECTS                             DATA      946     A
DATA            SPACE FOR IFF DATA              1.0                       ZEROS     DATA      947     A
DATA            SPIRE LIST                      1.0                       ZEROS     DATA      948     A
DATA            SPACE FOR MEASUREMENT DATA      1.0                       ZEROS     DATA      949     A
DATA    SPACE FOR LIST HEADER                   1.0                       ZEROS     DATA      950     A
DATA    OPTICS GRID                                                       BEG SET   DATA      951     A
DATA            IFLAG                           0.            INT                   DATA      952     A
DATA            DELTA AZIMUTH                   .4E-3                               DATA      953     A
DATA            DELTA ELEVATION                 .4E-3                               DATA      954     A
DATA    OPTICAL TRACK SIMULATION                                          BEG SET   DATA      955     A
DATA            KTYPE                           28.           INT                   DATA      956     A
DATA            OPTICAL TRACK TIME              99999.        SEC                   DATA      957     A
DATA    SPACE FOR SENSOR,OBJECT,TRACK FILE      3.0                       ZEROS     DATA      958     A
DATA            TRACK INT                       1.            SEC                   DATA      959     A
DATA    BORESIGHT                                                         REFER     DATA      960     A
DATA            CAN THE SENSOR ACQUIRE          YES                                 DATA      961     A
DATA            INITAL RANGE ERROR              1.0           KM                    DATA      962     A
DATA    *       SPIRE SENSOR PROCESSING BLOCKS                            BOX       DATA      963     A
DATA    SPIRE COMPUTATION LIST                                            BEG LIST  DATA      964     A
DATA    BLOCK 2                                                           REFER     DATA      965     A
DATA    BLOCK 3                                                           REFER     DATA      966     A
DATA    BLOCK 4                                                           REFER     DATA      967     A
DATA    BLOCK 5                                                           REFER     DATA      968     A
DATA    BLOCK 6                                                           REFER     DATA      969     A
DATA    BLOCK 7                                                           REFER     DATA      970     A
DATA    BLOCK 2                                                           BEG SET   DATA      971     A
DATA            BLOCK TYPE (SCAN)               4.                                  DATA      972     A
DATA            FIRST BRANCH                    1.                                  DATA      973     A
DATA            BRANCH INTERVAL                 1.                                  DATA      974     A
DATA            PERIOD                          1.27E-3                             DATA      975     A
DATA            SCAN LENGTH                     .8E-3                               DATA      976     A
DATA    BLOCK 3                                                           BEG SET   DATA      977     A
DATA            BLOCK TYPE (DETECTOR NOISE)     5.                                  DATA      978     A
DATA            BRANCH                          1.                                  DATA      979     A
DATA    BLOCK 4                                                           BEG SET   DATA      980     A
DATA            BLOCK TYPE (GAUSSMO)            6.                                  DATA      981     A
DATA            BRANCH                          1.                                  DATA      982     A
DATA            BANDPASS                        15000.                              DATA      983     A
DATA            4 SIGMA                         0.                                  DATA      984     A
DATA    BLOCK 5                                                           BEG SET   DATA      985     A
DATA            BLOCK TYPE (GAIN)               19.                                 DATA      986     A
DATA            BRANCH                          1.                                  DATA      987     A
DATA            GAIN                            1.                                  DATA      988     A
DATA     BLOCK 6                                                      BEG SET    DATA      989     A
DATA             BLOCK TYPE (GAIN)               17.                             DATA      990     A
DATA             BRANCH                          1.                              DATA      991     A
DATA             GAIN                            1.                              DATA      992     A
DATA     BLOCK 7                                                      BEG SET    DATA      993     A
DATA             BLOCK TYPE                      26.                             DATA      994     A
DATA             BRANCH                          1.                              DATA      995     A
DATA             X-POSITION AT SCAN START        -.4E-3                          DATA      996     A
DATA             Y-POSITION AT SCAN START        0.                              DATA      997     A
DATA             THRESHOLD                       100.                            DATA      998     A
DATA     *  BURST DATA                                                BCX PAGE   DATA      999     A
DATA     BURST COORDINATE CENTER                                      BEG SET    DATA     1000     A
DATA     COORD CENTER                            0.        -79.33    47.75   GEOGR      DATA     1001     A
DATA     BURST EVENT DATASET-1                                        BEG SET    DATA     1002     A
DATA              EVENT TYPE                     8.        INT                   DATA     1003     A
DATA             TIME                            99999.    SEC                   DATA     1004     A
DATA             POSITION                        0.        0.        200.    LCCXYZ     DATA     1005     A
DATA     BOMB-1                                                       REFER      DATA     1006     A
DATA     BURST EVENT DATASET-1                                        END SET    DATA     1007     A
DATA     BURST EVENT DATASET-2                                        BEG SET    DATA     1008     A
DATA              EVENT TYPE                     8.0       INT                   DATA     1009     A
DATA             TIME                            99999.    SEC                   DATA     1010     A
DATA             POSITION                        0.        0.        200.    LCCXYZ     DATA     1011     A
DATA     BOMB-2                                                       REFER      DATA     1012     A
DATA     BURST EVENT DATASET-2                                        END SET    DATA     1013     A
DATA     BURST EVENT DATASET-3                                        BEG SET    DATA     1014     A
DATA              EVENT TYPE                     8.0       INT                   DATA     1015     A
DATA             TIME                            99999.    SEC                   DATA     1016     A
DATA             POSITION                        0.        0.        200.    LCCXYZ     DATA     1017     A
DATA     BOMB-3                                                       REFER      DATA     1018     A
DATA     BURST EVENT DATASET-3                                        END SET    DATA     1019     A
DATA     BURST EVENT DATASET-4                                        BEG SET    DATA     1020     A
DATA             TYPE                            8.        INT                   DATA     1021     A
DATA             TIME                            99999.    SEC                   DATA     1022     A
DATA             POSITION                        0.        0.        200.    LCCXYZ     DATA     1023     A
DATA     BOMB-4                                                       REFER      DATA     1024     A
DATA     BURST EVENT DATASET-5                                        BEG SET    DATA     1025     A
DATA             TYPE                            8.        INT                   DATA     1026     A
DATA             TIME                            99999.    SEC                   DATA     1027     A
DATA             POSITION                        0.        0.        200.    LCCXYZ     DATA     1028     A
DATA     BOMB-5                                                       REFER      DATA     1029     A
DATA     *  WEAPON TYPE DATA                                          BCX        DATA     1030     A
DATA     *                                                            PRINT      DATA     1031     A
DATA     BOMB-1                                                       BEG SET    DATA     1032     A
DATA             NAME                            BOMB-1                          DATA     1033     A
DATA             YIELD                           1.0       MT                    DATA     1034     A
DATA             FFRAC                           .50                             DATA     1035     A
DATA             MFRAC                           .24                             DATA     1036     A
DATA             NFRAC                           .01                             DATA     1037     A
DATA             XFRAC                           .75                             DATA     1038     A
DATA             THRML NFRAC                     .50                             DATA     1039     A
DATA             GFRAC                           .001                            DATA     1040     A
DATA            WMASS                                  1.5E6     GM                         DATA    1041    A
DATA            FRACTION ALUMINUM                      0.05                                 DATA    1042    A
DATA            SPACES                                 2.0                         ZEROS    DATA    1043    A
DATA            FRACTION URANIUM                       0.45                                 DATA    1044    A
DATA     DEVICE DEPENDENT ENERGY SPECTRUM DATA =1                                  REFER    DATA    1045    A
DATA     SPACE FOR ENERGY SPECTRUM DATA                1.0                         ZEROS    DATA    1046    A
DATA     BOMB=2                                                                    BEG SET  DATA    1047    A
DATA            NAME                                   BOMB=2                               DATA    1048    A
DATA            YIELD                                  1.0       MT                         DATA    1049    A
DATA            FFRAC                                  .10                                  DATA    1050    A
DATA            HFRAC                                  .24                                  DATA    1051    A
DATA            NFRAC                                  .01                                  DATA    1052    A
DATA            XFRAC                                  .75                                  DATA    1053    A
DATA            THRML NFRAC                            .50                                  DATA    1054    A
DATA            GFRAC                                  .001                                 DATA    1055    A
DATA            WMASS                                  1.5E6     GM                         DATA    1056    A
DATA            FRACTION ALUMINUM                      0.05                                 DATA    1057    A
DATA            SPACES                                 2.0                         ZEROS    DATA    1058    A
DATA            FRACTION URANIUM                       0.45                                 DATA    1059    A
DATA     DEVICE DEPENDENT ENERGY SPECTRUM DATA =2                                  REFER    DATA    1060    A
DATA     SPACE FOR ENERGY SPECTRUM DATA                1.0                         ZEROS    DATA    1061    A
DATA     BOMB=3                                                                    BEG SET  DATA    1062    A
DATA            NAME                                   BOMB=3                               DATA    1063    A
DATA            YIELD                                  1.0       MT                         DATA    1064    A
DATA            FFRAC                                  .10                                  DATA    1065    A
DATA            HFRAC                                  .24                                  DATA    1066    A
DATA            NFRAC                                  .01                                  DATA    1067    A
DATA            XFRAC                                  .75                                  DATA    1068    A
DATA            THRML NFRAC                            .50                                  DATA    1069    A
DATA            GFRAC                                  .001                                 DATA    1070    A
DATA            WMASS                                  1.5E6     GM                         DATA    1071    A
DATA            FRACTION ALUMINUM                      0.05                                 DATA    1072    A
DATA            SPACES                                 2.0                         ZEROS    DATA    1073    A
DATA            FRACTION URANIUM                       0.45                                 DATA    1074    A
DATA     DEVICE DEPENDENT ENERGY SPECTRUM DATA =3                                  REFER    DATA    1075    A
DATA     SPACE FOR ENERGY SPECTRUM DATA                1.0                         ZEROS    DATA    1076    A
DATA     BOMB=4                                                                    BEG SET  DATA    1077    A
DATA            NAME                                   BOMB=4                               DATA    1078    A
DATA            YIELD                                  1.0       MT                         DATA    1079    A
DATA            FFRAC                                  .10                                  DATA    1080    A
DATA            HFRAC                                  .24                                  DATA    1081    A
DATA            NFRAC                                  .01                                  DATA    1082    A
DATA            XFRAC                                  .75                                  DATA    1083    A
DATA            THRML NFRAC                            .50                                  DATA    1084    A
DATA            GFRAC                                  .001                                 DATA    1085    A
DATA            WMASS                                  1.5E6     GM                         DATA    1086    A
DATA            FRACTION ALUMINUM                      0.05                                 DATA    1087    A
DATA            SPACES                                 2.0                         ZEROS    DATA    1088    A
DATA            FRACTION URANIUM                       0.45                                 DATA    1089    A
DATA     DEVICE DEPENDENT ENERGY SPECTRUM DATA =4                                  REFER    DATA    1090    A
DATA     SPACE FOR ENERGY SPECTRUM DATA                1.0                         ZEROS    DATA    1091    A
DATA     BOMB=5                                                                    BEG SET  DATA    1092    A
DATA          NAME                                 BOMB-5                                 DATA     1093     A
DATA          YIELD                                1.0      MT                            DATA     1094     A
DATA          FFRAC                                .10                                    DATA     1095     A
DATA          HFRAC                                .24                                    DATA     1096     A
DATA          NFRAC                                .01                                    DATA     1097     A
DATA          XFRAC                                .75                                    DATA     1098     A
DATA          THRML NFRAC                          .50                                    DATA     1099     A
DATA          GFRAC                                .001                                   DATA     1100     A
DATA          WMASS                                1.5E6    GM                            DATA     1101     A
DATA          FRACTION ALUMINUM                    0.05                                   DATA     1102     A
DATA          SPACES                               2.0                       ZEROS        DATA     1103     A
DATA          FRACTION URANIUM                     0.45                                   DATA     1104     A
DATA     DEVICE DEPENDENT ENERGY SPECTRUM DATA -5                            REFER        DATA     1105     A
DATA     SPACE FOR ENERGY SPECTRUM DATA            1.0                       ZEROS        DATA     1106     A
DATA     DEVICE DEPENDENT ENERGY SPECTRUM DATA -1                            BEG SET      DATA     1107     A
DATA     FLAG FOR INITIALIZATION                   START                                  DATA     1108     A
DATA     NEUTRON WEAPON DEPENDENT DATA                                       REFER        DATA     1109     A
DATA     GAMMA WEAPON DEPENDENT DATA                                         REFER        DATA     1110     A
DATA     X-RAY WEAPON DEPENDENT DATASET1.0                                   REFER        DATA     1111     A
DATA        SPACE FOR X-DATA                       1.0                       ZEROS        DATA     1112     A
DATA        SPACE FOR N-DATA                       1.0                       ZEROS        DATA     1113     A
DATA        SPACE FOR G-DATA                       1.0                       ZEROS        DATA     1114     A
DATA     DEVICE DEPENDENT ENERGY SPECTRUM DATA -2                            BEG SET      DATA     1115     A
DATA          FLAG                                 START                                  DATA     1116     A
DATA     NEUTRON WEAPON DEPENDENT DATA                                       REFER        DATA     1117     A
DATA     GAMMA WEAPON DEPENDENT DATA                                         REFER        DATA     1118     A
DATA     X-RAY WEAPON DEPENDENT DATASET1.0                                   REFER        DATA     1119     A
DATA          SPACES                               3.0                       ZEROS        DATA     1120     A
DATA     DEVICE DEPENDENT ENERGY SPECTRUM DATA -3                            BEG SET      DATA     1121     A
DATA          FLAG                                 START                                  DATA     1122     A
DATA     NEUTRON WEAPON DEPENDENT DATA                                       REFER        DATA     1123     A
DATA     GAMMA WEAPON DEPENDENT DATA                                         REFER        DATA     1124     A
DATA     X-RAY WEAPON DEPENDENT DATASET1.0                                   REFER        DATA     1125     A
DATA          SPACES                               3.0                       ZEROS        DATA     1126     A
DATA     DEVICE DEPENDENT ENERGY SPECTRUM DATA -4                            BEG SET      DATA     1127     A
DATA          FLAG                                 START                                  DATA     1128     A
DATA     NEUTRON WEAPON DEPENDENT DATA                                       REFER        DATA     1129     A
DATA     GAMMA WEAPON DEPENDENT DATA                                         REFER        DATA     1130     A
DATA     X-RAY WEAPON DEPENDENT DATASET1.0                                   REFER        DATA     1131     A
DATA          SPACES                               3.0                       ZEROS        DATA     1132     A
DATA     DEVICE DEPENDENT ENERGY SPECTRUM DATA -5                            BEG SET      DATA     1133     A
DATA          FLAG                                 START                                  DATA     1134     A
DATA     NEUTRON WEAPON DEPENDENT DATA                                       REFER        DATA     1135     A
DATA     GAMMA WEAPON DEPENDENT DATA                                         REFER        DATA     1136     A
DATA     X-RAY WEAPON DEPENDENT DATASET1.0                                   REFER        DATA     1137     A
DATA          SPACES                               3.0                       ZEROS        DATA     1138     A
DATA     *WEAPON DEPENDENT DATA FOR DEPOSITION CALCULATIONS                  BOX PAGE     DATA     1139     A
DATA     X-RAY WEAPON DEPENDENT DATASET0.5                                   BEG SET      DATA     1140     A
DATA     SPECX              3.0        18.0       (7(E9.3,2X))               FORMAT       DATA     1141     A
DATA     2.820E-03, 1.640E-02, 9.100E-02, 1.740E-01, 4.710E-01, 2.360E-01, 9.640E-03,     DATA     1142     A
DATA     2.960E-06                                                                        DATA     1143     A
DATA                                                                                      DATA     1144     A
DATA     END DATA                                                                  DATA     1145     A
DATA     X-RAY WEAPON DEPENDENT DATASET1,0                               BEG SET   DATA     1146     A
DATA     SPECX               3,0         18,0        (7(E9,3,2X))        FORMAT    DATA     1147     A
DATA     3,610E-04, 2,440E-03, 1,640E-02, 4,170E-02, 2,230E-01, 4,710E-01, 2,360E-01,   DATA     1148     A
DATA     9,350E-03, 1,920E-04                                                      DATA     1149     A
DATA                                                                               DATA     1150     A
DATA     END DATA                                                                  DATA     1151     A
DATA     X-RAY WEAPON DEPENDENT DATASET2,0                               BEG SET   DATA     1152     A
DATA     SPECX               3,0         18,0        (7(E9,3,2X))        FORMAT    DATA     1153     A
DATA     4,940E-05, 3,310E-04, 2,440E-03, 7,020E-03, 5,110E-02, 2,230E-01, 4,710E-01,   DATA     1154     A
DATA     1,910E-01, 4,510E-02, 8,110E-03, 1,240E-03, 1,710E-04                     DATA     1155     A
DATA                                                                               DATA     1156     A
DATA     END DATA                                                                  DATA     1157     A
DATA     NEUTRON WEAPON DEPENDENT DATA                                   BEG SET   DATA     1158     A
DATA     SPECN               3,0         18,0        (8(E8,2,2X))        FORMAT    DATA     1159     A
DATA     0,01E-02, 2,00E-03, 2,40E-02, 1,22E-01, 3,65E-01, 1,02E-01, 8,50E-02, 6,20E-02,   DATA     1160     A
DATA     2,80E-02, 5,00E-03, 1,90E-02, 2,60E-02, 1,70E-02, 1,80E-02, 1,47E-02, 1,41E-02,   DATA     1161     A
DATA     2,56E-02, 7,06E-02                                                        DATA     1162     A
DATA     END DATA                                                                  DATA     1163     A
DATA     GAMMA WEAPON DEPENDENT DATA                                     BEG SET   DATA     1164     A
DATA     SPECG               3,0         18,0        (8(E8,2,2X))        FORMAT    DATA     1165     A
DATA     3,08E-02, 1,36E-02, 8,16E-02, 6,87E-02, 8,67E-02, 1,77E-01, 1,40E-01, 1,00E-01,   DATA     1166     A
DATA     1,07E-01, 6,18E-02, 3,94E-02, 3,76E-02, 2,23E-02, 2,12E-02, 7,48E-03, 3,23E-03,   DATA     1167     A
DATA     6,74E-04, 1,58E-04                                                        DATA     1168     A
DATA     END DATA                                                                  DATA     1169     A
DATA     SPECD               3,0         18,0        (8(E8,2,2X))        FC  AT    DATA     1170     A
DATA     1,11E-03, 3,80E-03, 1,40E-02, 2,09E-02, 2,62E-02, 6,35E-02, 7,13E-02, 7,36E-02,   DATA     1171     A
DATA     1,17E-01, 1,05E-01, 9,14E-02, 1,04E-01, 7,34E-02, 8,19E-02, 3,51E-02, 1,70E-02,   DATA     1172     A
DATA     4,12E-02, 9,94E-04                                                        DATA     1173     A
DATA     END DATA                                                                  DATA     1174     A
DATA     *   THE ENVIRONMENT OUTPUT AND STOP EVENTS **                   BOX PAGE  DATA     1175     A
DATA     ENVIRONMENT OUTPUT EVENT                                        BEG SET   DATA     1176     A
DATA               TYPE OF EVENT                      11,0      INT                DATA     1177     A
DATA               OUTPUT TIME                        99999,    SEC                DATA     1178     A
DATA               TYPE                               NONE                         DATA     1179     A
DATA               NPTS                               1,0       INT                DATA     1180     A
DATA               OUTPUT TIME INT                    30,       SEC                DATA     1181     A
DATA               END PRINT TIME                     1731,     SEC                DATA     1182     A
DATA               FREQUENCY                          450,      MHZ                DATA     1183     A
DATA               EVENT INITIALIZATION FLAG          1,0       INT                DATA     1184     A
DATA     GRID OUTPUT DATASET                                             REFER     DATA     1185     A
DATA     SPACE FOR INTERNAL STORAGE                   1,0                ZEROS     DATA     1186     A
DATA     GRID OUTPUT DATASET                                             BEG SET   DATA     1187     A
DATA               TYPE                               FIREBALL                     DATA     1188     A
DATA               INDEX                              1,        INT                DATA     1189     A
DATA               PLOT PARALLEL TO                   Y-AXIS                       DATA     1190     A
DATA               KIND OF OUTPUT DESIRED             ALL                          DATA     1191     A
DATA     STOP EVENT                                                      BEG SET   DATA     1192     A
DATA          TYPE OF EVENT                           10,       INT                DATA     1193     A
DATA               STOP TIME                          0,        SEC                DATA     1194     A
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